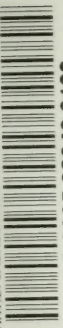


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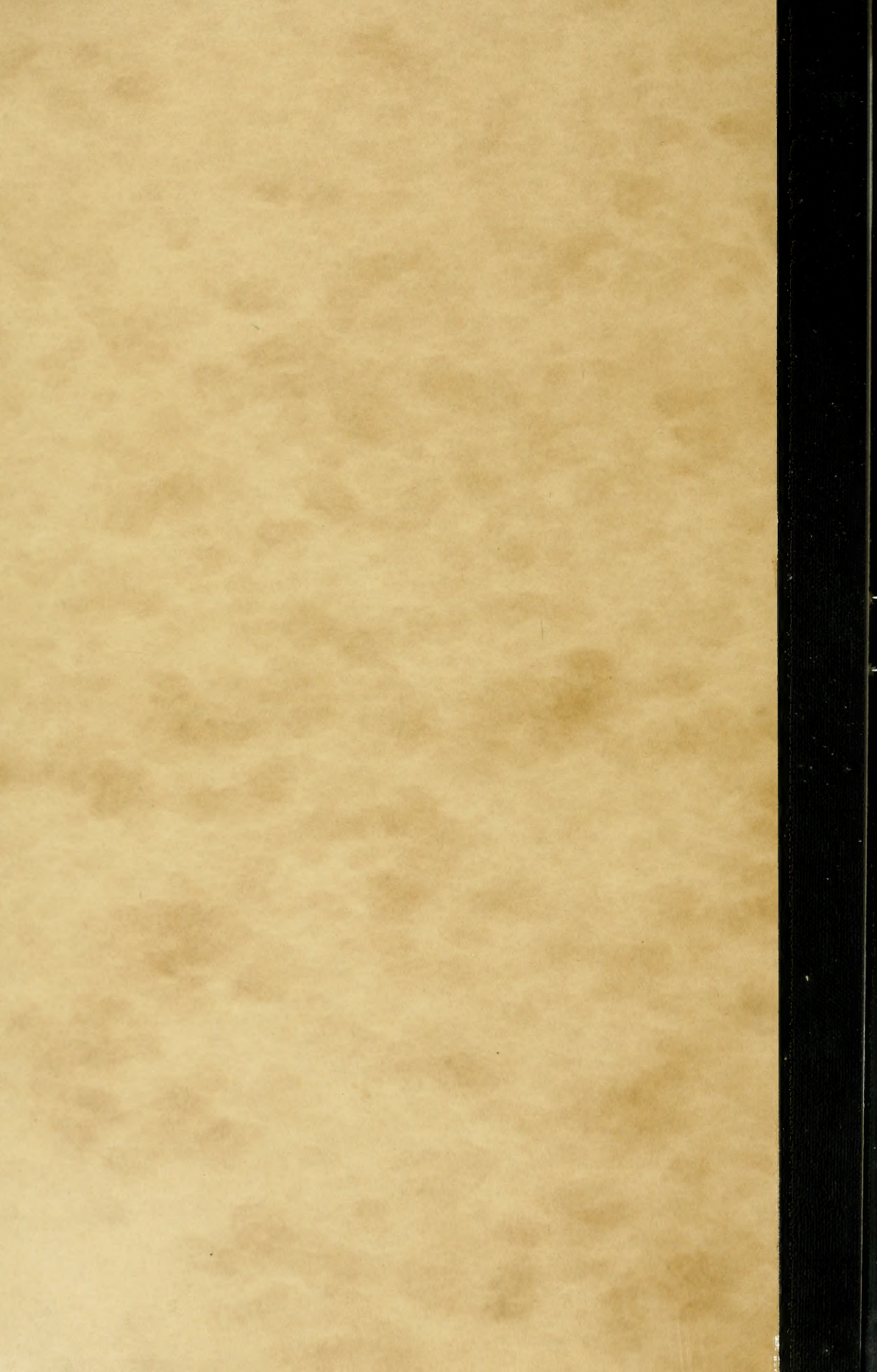
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A Qualitative Analysis of the Process of Forgetting

BY

HAROLD R. CROSLAND, PH.D.
Assistant Professor of Psychology, University of Oregon

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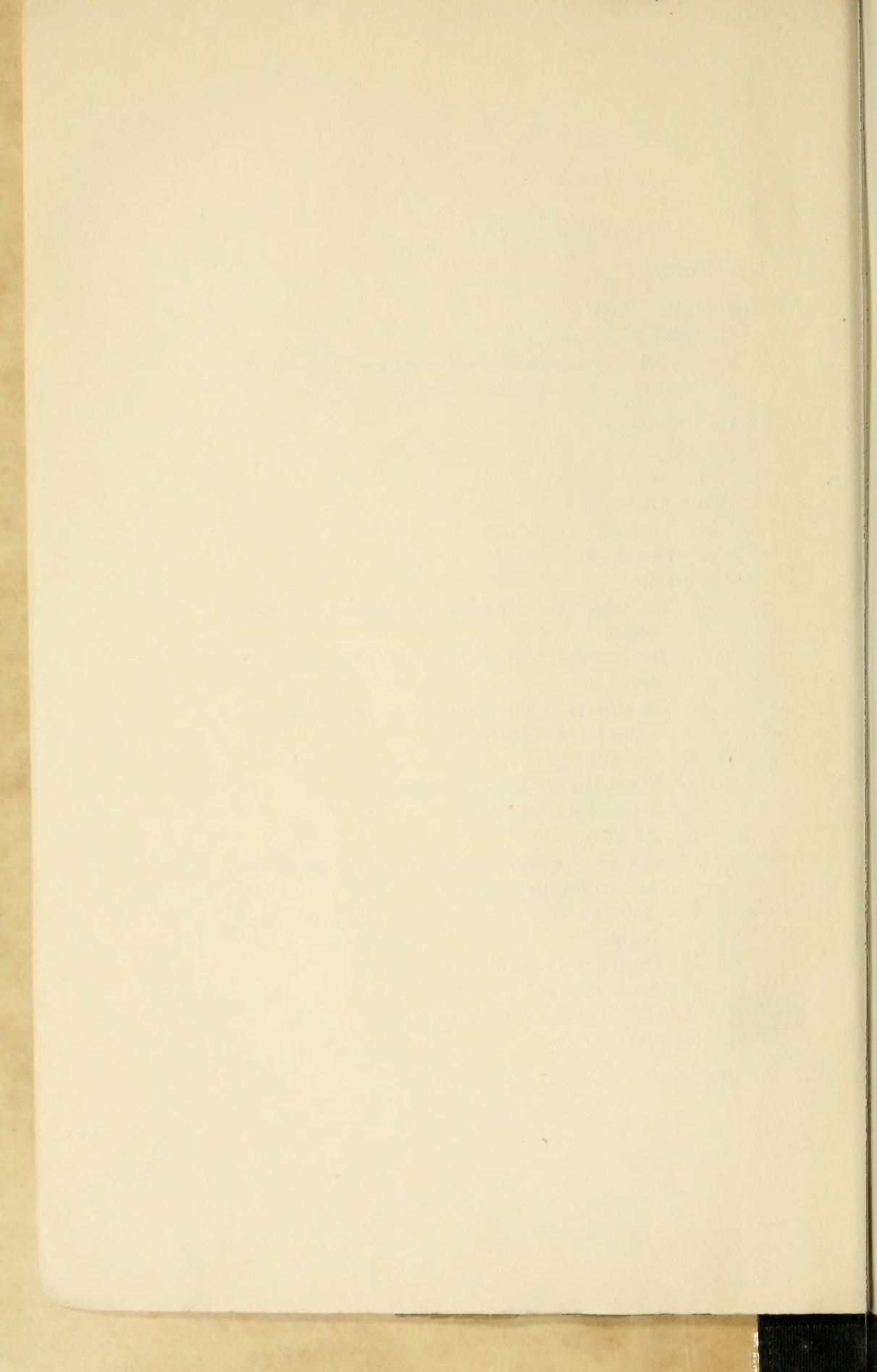
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A QUALITATIVE ANALYSIS OF THE PROCESS OF FORGETTING

I. INTRODUCTION

The investigation which is here reported attempts to determine what qualitative changes of memorial content take place with the lapse of time. Our procedure has consisted in making a series of cross-sections through an individual's remembrance of a given experience, and then in examining and comparing the contents of these various cross-sections with a view to discovering what changes are revealed. It was hoped by this means to supplement the investigations in which Ebbinghaus and others have determined the quantitative relations of the process of forgetting.

We have not attempted to discover how much forgetting has taken place at any stage of the process. It has been our endeavor to contribute to the solution of the general problem: What constitutes forgetting? What actually takes place when an individual forgets? What processes are inherent in forgetting? How do these processes manifest themselves after various periods of time? In what manner are images affected by the lapse of time? What influence is exerted upon the process of recall by age of impression and degree of obliviscence? Do new processes make their appearance in a progressive series of remembrances of an experience to facilitate or to hinder recall?

II. HISTORICAL REVIEW

The history of psychology is replete with references to memory, but we find few clear-cut conceptions of what is the essential nature of the process of forgetting. For this reason one finds it impossible to formulate a rigid classification of the different theories of forgetting. There have been and are to-day current popular notions of forgetting; most people recognize the fact that, as time elapses, events, or series of events, which at one time were easily recalled, return to consciousness more rarely and in paler colors, and can be reproduced only with increasing difficulty.

I. GENERAL THEORIES

One of the earliest views to be found in the literature holds that experiences are forgotten in consequence of the fact that our present perceptions tend to swamp and bury our images. The images are however not completely destroyed; they come to light again when, for any reason, the superimposed layers of impressions are removed. This conception may be traced to Aristotle (16); in modern times it has been advocated by Delboeuf (49) and others. A second conception of forgetting, advocated by Herbart (73) and others, holds that images persist but they suffer mutilation and obscuration. Old impressions are repressed and covered over by more recent experiences; and, with the lapse of time, the clearness and the intensity of the older images are impaired. Associations of images also undergo a similar progressive decadence; ideas tend to become resolved into their component elements, which in turn are re-combined or assimilated into new constellations. The complete decay of an image does not take place until after a very long time, after oft-repeated repressions. The repressed residua are not conceived of as pale images, but as "tendencies" or "dispositions" which determine the direction and the form of the assimilation taking place in the memorial contents. If these "tendencies"

are supported and strengthened by means of association or by repetition, the "obscuring" or the "hindering" ideas themselves are submerged and the older, forgotten idea now emerges from obscurity into clear consciousness. A third conception of forgetting, that of Lotze (101 and 102), maintains that the process of forgetting is a crumbling of the idea and the losing of some of its component elements; forgetting is not a process of general obscuration. In a somewhat similar fashion Renda (158) conceives that forgetting is not merely an accidental mental function, but rather that forgetting is in nature essentially an active process of dissociation. Forgetting is a means by which consciousness rids itself of useless and excess lumber; and this active principle of dissociation bears a close similitude to the principle of natural selection in biology—forgetting is the essential factor of mental evolution.

Freud (61) maintains in his dream-psychology that the data of experience are neither forgotten nor lost, in the sense that they decay and fade away, but they are repressed into the so-called unconscious realm of mind and here they live an active and a dynamic life, coloring one's views, one's thoughts, and one's ideals. The contents repressed into this unconscious dungeon escape from it into the consciousness of dreams through means of disguises, and these disguises (mechanisms¹ of *Condensation*, *Displacement*, *Dramatization* and *Secondary Elaboration*) are employed to fool a hypothetical *censor* or guard who patrols the region separating the conscious from the unconscious. The avowed purpose of the *censor* is to repress sexual thoughts into the unconscious and to keep them out of the conscious. Whether this supposed *censor* is another idea, or another complex, or a brain cell, or a nervous mechanism, Freud does not tell us. In his *Psycho-Pathology of Everyday Life* (62), he still leans toward his sexual theory of forgetting,—he supposes that such forms of forgetting² as slips of pen (*Verschreiben*), slips of tongue (*Versprechen*), mislayings of objects (*Ver-*

¹ Of these mechanisms we shall have something to say in Section III B iii a, pages 68 to 71 of this paper.

² See Frink (63) and Ranschburg (156).

legen), misreadings (*Verlesen*), slips of memory (*Vergessen von Namen, Daten, u.s.w.*), and misapprehensions (*Vergreifen*),—all these forms of forgetting, and others, are due to the unpleasantness of the forgotten content or to the unpleasantness of some content associated with the forgotten content and, on account of the unpleasantness, the forgotten content was once upon a time forced or repressed out of consciousness either directly, or indirectly by association; the act of repression caused the mislaying and the distortion of the memorial datum. In other words, “a failure to remember is a not wanting to remember” something unpleasant. Repression is a biological mechanism of defense (similar to Renda’s active dissociation) and its function is to guard mind from unpleasant memories.

But Ranschburg’s (156) rejoinder is that “the Freudian manner of explaining the phenomena of name-forgetting and of compensating-names (concealing memories) is, in view of all the work on the subject, superfluous throughout, when its entire lack of substantiation is taken into account.” Against the concept of forgetting as the effect of displeasure motives, Ranschburg accounts for the various phenomena on the basis of two factors, namely, first, associative or reproductive inhibition due to similarity, that is illusion by means of images simultaneously aroused which have been strongly fused through practice; and second, the state of attention with which the original imprinting was accomplished (or was not thoroughly accomplished).³ Full concentration of attention and mental freshness serve to imprint a datum in a true and faithful manner; but, if attention be distracted, while the presentation or the imprinting is being done, by simultaneously effective stimuli, the recalls throughout the course of forgetting will be attended by perseverative images and with many forms of permutations and compensatory reproductions, all in the nature of those forms of forgetting⁴ which

³ See Huguenin’s (77) conception of what he terms “paradoxical revival,” namely recalls which are most complete after a period of time has elapsed since learning, a phenomenon which he attributes to the influence of distractions on memorizing; this view is also held by Cionci (38). See also our discussion on page 76 ff.

⁴ See Bawden’s study of mental lapses (22) and Fletcher’s investigation of stuttering (59).

Freud has attempted to explain on a hedonic principle. Ranschburg draws evidence in support of his position from Müller (124) and Müller and Schumann,⁵ who have extensively investigated a great many of the manifold problems and phenomena of memory, of remembering and of forgetting.

As regards the rôle of repression in forgetting, Pear (138) has sought to differentiate between capricious or temporary forgetting and the more permanent fading out of the memorial contents; the former he explains on the basis of a principle of active repression, somewhat in the fashion of Freud. Wolf (138) refuses to accept Pear's differentiation of the two kinds of forgetting, and, by means of the orthodox laws of retention and recall, he seeks to explain all forms of forgetting, and asserts that the resistance, or repression, theory is unsupported by facts. Mitchell (138) maintains that some forms of normal and abnormal forgetting, at least, are most easily explained by the hypothesis of repression, but that not all mental dissociation and not all forgetting can be accounted for on the assumption of repression and the attempts of the person to avoid pain or displeasure. Loveday (138) states that most cases of normal forgetting are not to be explained by assuming that there was a will or desire to forget; the Freudian view implying that every content to be recalled must be present all the time in the unconscious is an absurdity and had its origin in Freud's associationism.

Jones (80) maintains that all forgetting is partly due to repression. The unconscious residua of mind have been shown by psycho-analysis to be extremely great, and complexes of these residua exert an assimilative force of very great proportions. Due to the extent of the content and its assimilative activity, the associations in the unconscious are so manifold and so complex that one cannot at any time say that a given idea has never been associated with some unpleasant idea or group of ideas. And, as Renda has already stated, mental economy and mental efficiency demand that consciousness be relieved of its irrelevant

⁵ *Experimentelle Beiträge zur Untersuchung vom Gedächtnis*. Leipzig, 1894. Also from Müller and Pilzecker, *Experimentelle Beiträge zur Lehre vom Gedächtnis*. Leipzig, 1900.

contents which might be in the way when it were necessary to concentrate upon matters of more vital import. This utilitarian repression would serve for purposes of explanation just as well as Freud's hedonic mechanism of repression. All selective thinking, at bottom, is a result of this extended principle of repression.⁶

Abramowski (1, 2, 3 and 4) conceives that each impression of a datum arouses a peculiar feeling; and, in time, the impressed datum of memory may be lost or forgotten, but this is never true of the feeling which was germane to that particular impression,—the feeling persists in its original form and is called a "generic feeling." The fusion of this feeling with some later datum of impression will constitute a perception; if the two are separated, the feeling develops into an image which is associated with the impressed datum. This "generic feeling" is the very core of the recognition consciousness. A person's being unable to recall just what a certain datum was, and yet is able to remember what it was not, is due, according to Abramowski, to the fact that this "generic feeling" resists forgetting—it restrains false data from entering and filling the lacunae of memory; although its brother datum has in the course of time been lost, it itself is still active and resists the entrance of other data to supplant the lost member. This conception is almost wholly hypothetical, and we shall attempt to determine whether or not it will hold good in our experiment.

In an attempt to explain memory in terms of the retention of traces of nerve stimulations, Piéron (150 and 151) and Robertson (160) have both asserted that the fatigue or waste products

⁶Wells (203), in discussing emotional continuity and emotional transference, cites many interesting cases which exemplify the fact that *affects* are drained from the original memory contents and loaded on to related and unrelated contents, the original datum, which in the first instance caused the *affect*, having been forgotten or submerged. He states, however (p. 126), that the "loaded" content, which one would suppose was equally subject to being suppressed itself if its *affect* is unpleasant, is not repressed or submerged. This important state of affairs argues against the repression theory of forgetting of Jones and Freud. Indeed, Wells states that unpleasantness is not a sufficient cause to account for many seeming phenomena of repression.

generated in the neurones by stimulation accumulate and act as auto-catalysors. Robertson goes even so far as to attempt an explanation of forgetting on the same principle. He conceives that forgetting is due to the fatigue products being slowly washed out of the neurones by fluids which circulate through the nerve elements. He compares the curve of forgetting, determined by Ebbinghaus, with two curves which he himself has obtained, one for the rate of extraction of protamine from dried salmon spermatozoa by a dilute solution of hydrochloric acid, and the other representing the rate of solution of dry casein by .0087 "normal" potassium hydroxid; he finds a striking similarity between the three curves. On the basis of this similarity he postulates the hypothesis that the "memory trace" is, rapidly at first and more slowly in the course of time, washed out of the neurones by the circulating fluids; this washing out accounts for the dimming, the fading out, and the becoming discrete which are characteristic of images as they in the course of time decay.

2. AFFECTIVE MEMORY—EXPERIMENTAL AND THEORETICAL

As regards the question of the remembrance of pleasant and unpleasant experiences, Colegrove (42) on the basis of questionnaire returns from whites, Indians, and negroes, in answer to the question, "Which do you remember better, pleasant or unpleasant experiences?" found the general result that more pleasant impressions are remembered than unpleasant ones. Kowalewski (86), presenting a similar question to 270 boys and girls, obtained results similar to those of Colgrove. Tait (179) presented to his observers words which he supposed would be attended by pleasantness, or unpleasantness, or indifference. From his numerical results, it was found that pleasant impressions are remembered better than unpleasant impressions, and both are remembered better than indifferent impressions. Gordon (68) presented to her observers figures and squares of colors, which were to arouse pleasantness, unpleasantness, or indifference; introspections were required as to whether or not the materials did actually arouse in the observers certain feelings. She found that there was no difference in the amounts

of remembrances of pleasant, unpleasant and indifferent impressions. Gordon points out that the mere recalling of a greater number of former pleasant experiences does not necessarily mean that pleasantness contributes to retention or that unpleasantness has an obscuring effect.

Discussing the fact that unsuccessful movements (being supposed to be disagreeable) tend to be sloughed off in the course of learning and that correct movements (being supposed to be agreeable) are retained, Hollingworth (74) maintains that mind "naturally" forgets the unpleasant and magnifies the pleasant in memory. In support of this view, he cites, as illustrations, the "canonization of saints, the apotheosis of strenuous historic characters, the obituaries of our friends, the reminiscences of childhood." There is, he says, "a universal habit of forgetting the bad and exalting the good." (P. 711) "In any process of learning, movements that miss the goal or result in dissatisfaction *leave no trace* in the nervous system and are forgotten." (! ! ! !)"But responses that result in success or that yield even a secondary satisfaction become, by virtue of that very ensuing glow of pleasure, re-enforced or fixed in the nervous system." Henderson (71) agrees with Hollingworth that in the simplest kinds of learning, movements which lead to unpleasantness are eliminated or are banished, but he doubts that we forget our unpleasant experiences in general. He asked ten observers to recall incidents of their past experiences and to grade the remembered events into groups on the basis of their feeling tones. His results showed that the remembrances were agreeable (which does not mean that agreeable experiences were remembered always, but that the act of remembering was agreeable) but he does not accept an affirmative answer to the question of whether or not the pleasant experiences are better remembered than the unpleasant. Peters (141) required his observers to recall, in reply to a stimulus-word, some of their past experiences and the observers were also to report the affective aspect of their original experiences as well as of their recall. Fifty-two per cent. of the experiences were reported as

pleasant; recent events were less pleasant than earlier events.⁷ In the preponderance of pleasant or unpleasant experiences in memory there were individual differences among the reagents. There were individual differences as to the constancy of the affective process that attached itself to a certain event in its repeated recalls from memory. In line with Hollingworth, or as the originator of the theory, Thorndike (181 and 183) maintains that in the acquiring of vountary movements, the successful movement brings pleasantness which stamps in the neural connections necessary for that movement, and that the unsuccessful movement induces unpleasantness which stamps out incorrect or useless connections in the nervous system. Watson (198) mantains first, that not all successful acts are pleasant and not all unsuccessful acts are unpleasant; second, that acts other than the successful acts are fixed or are stamped in. He therefore holds that pleasure and displeasure have nothing to do with remembering.

3. MEMORY AND FORGETTING IN GENERAL—EXPERIMENTAL

The assumption was current in the psychology of a few years ago that in acts of recognizing and judging the intervention of a memory image was a necessary and an essential process. Wolfe (209), working on the memory and recognition of tones after various short time intervals, and Lehmann (98), on the recognition and judging of the brightness of greys, assumed the interposition of a memory image in the recognitive consciousness. Starke (172), Merkel (112), Lehmann (99), and Tschisch (193) discovered that when two sounds objectively equal in intensity are given in succession, the second sound is judged to be the louder. This phenomenon they explain on the assumption that the memory image of the first sound holds over until the second sound is perceived but in the meanwhile has diminished in its intensity. In fact, the assumption of a memory image, with its qualitative and quantitative alterations, has been the basis of explanation of the phenomena of over-estimation and under-

⁷ Cf. the discussion of the causes of affection on pages 89, 90, 91, and 92 of this paper.

estimation in most of the earlier works on judgment. Still assuming the intervention of memory images in acts of judging, Leuba (100), working on the classification of artificial stars of different intensities, found (p. 382 f.) that "the image of a recent sensation tends to recall by association, the united residual of all the past sensations of the same kind," and since the past sensations varied between high and low intensities, the obvious result occurs that there is "a natural tendency to shift the sensations held in memory towards the middle of the scale."⁸ Numerous other studies of judgment and recognition might here be cited; many of them assume the presence of a memory image in order to explain the phenomena of over- and under-estimation, and the approach toward mid-types which are to be found in judgments and in reproductions of sense impressions; such phenomena, the investigators claim, are traceable to the qualitative and quantitative alterations effected in memory images by the lapse of time.

Kennedy (84) was the first writer to urge that special careful work of an analytical nature be undertaken in regard to the qualitative aspects of the memory consciousness with the lapse of time. Bentley (23) and Whipple (205) took up the cry. And Kuhlmann (89, 90 and 91) has laid great stress on the necessity of accurate and detailed analyses of the memory consciousness with regard to particular recalls and the alterations incident with the lapse of time.

We shall now attempt to trace the investigations undertaken along lines similar to the suggestions made by Kennedy, Bentley, Whipple, and Kuhlmann.

Philippe (145), 1897, appears to have been the first investigator to attack the problem of an analytic study of the image for its own sake. The problem he had in mind was two-fold: first, how do images arise and develop? and second, how do images transform themselves and disappear? Using as learning materials five common objects, such as a silver-plated screw, a trousers button, a velvet cravat bearing a cameo of the head of Caesar, a crochet stencil of copper, and a small Japanese mask,

⁸ Cf. also studies by Wolfe (210) Baldwin and Shaw (20), Warren and Shaw (194), and Clark (41).

the experimenter placed an object in the right hand of an observer who had his eyes closed, and instructed the observer to visualize the object; when a definite visual image was reported, the experimenter removed the object and kept it out of view. The observer with open eyes now reproduced the object by drawing it as completely as he could. Then with closed eyes the observer went through the same procedure again with the same object, in an attempt to build up a complete and definite visual image. After the learning, at intervals of four or five days, one and two months, reproduced drawings were made in as accurate a fashion as the observer could recall the object. Six adults, reporting in the course of seven months a total of one hundred and thirty images, and thirty school children, ages from five to eight years, took part in the experiment. From comparisons of the reproductions Philippe found that: 1. The image tends to disappear in the manner of a confusion and an abstracting process, becoming vague and indefinite; it loses details to the point of being only a schema of the original object. 2. The image, on the other hand, tends to become more precise, taking another form and passing over into another set of images; there is a replacement by other details which give the image its individuality and yet transform it into a concrete image of wholly another type. 3. The image gradually approaches in some degree a general or common type representing the group of which it is a member; this process of generalization is quite frequent; and this evolution toward a general type proceeds by transformations which are easy to trace. In general, the investigator believed that, through the law of economy, useless details of an image-complex of experience crumble away, in the process of forgetting, in order to make way for the more useful elements which are themselves undergoing an assimilation into a new unity. In another study (146) Philippe made use of a questionnaire, *quasi-introspective* method, with ten laboratory students and professors of psychology habituated in some degree to observing their mental phenomena and a fifteen year old child. These instructions were given (p. 510): "How many visual images of each of the

following objects can you call to mind,—the statue of Venus de Milo, an ordinary pin, a cigarette, the type of capital 'A', and your mother's face? Enumerate the images of each object in order of definiteness; describe each image carrying all of its details and bearing an individual character; and separate clearly all other kinds of images. Indicate and describe finally the images which at first you failed to mention." The introspective replies are published; and Philippe, with much speculation, thought he had found three types of image, namely: 1. the complete, detailed, definite image, individual and particular in character, inseparably fused with the localizations of its constituent parts, and with the place and the time of the original presentation; 2. a transitional form of image, in which one part or another begins to stand out more focally than the others, somewhat representatively, and in which localization in time and place gradually begin to be lost—the image becoming less distinct and less concise; and 3. the general and abstract image, having no *particular* elements in its constitution, being vague and schematic in character, rapid and transitory and evanescent in temporal course. From all of which this investigator concluded that images do not exist side by side, but they superpose themselves one on the other and fuse one within the other, and thus approach generalization. Each image (of a given object) is affected by the preceding image (of the same object) and in turn influences the next succeeding image. And, of a given object, the images are less in number in proportion to the large number of previous representations fused into them; to the less degree in which an image contains within itself numerous previous representations, just so much more concrete is it. Abstract images are those images which have frequently been renewed by impressions under slightly or greatly dissimilar conditions; but if renewed always under the same conditions, the image becomes more and more concrete. Memory is immutable; but this is not true of images. Transformation and fusion of mental images are only expressions of the tendency of mind to generalize.

Bentley (23) attempted to determine the exact place of the

image in the memory consciousness and to discover the changes which the image undergoes in the course of time. He planned an experiment by which visual images of colors and brightnesses could be aroused. His materials consisted of colors and brightnesses, which were presented by means of the Marbe adjustable color-mixer for a period of five seconds (series I, II); and after one, or five minutes, and sometimes a few days (series I; one, two, three, or five minutes in series II), a comparison stimulus was given. Just before the conclusion of the interval between stimuli the observer was asked whether he had a visual image of the first, or standard, stimulus, and, after the presentation of the comparison stimulus, the observers (who were five instructors and six students of psychology in Cornell University) reacted with one of the judgments "same," "greater," or "less," the method being that of *recall and comparison*. The observers also reported as to the characteristics of their imagery, whether definite, clear and distinct, or vague and confused,—or no image whatever. The observers were instructed not to attend to the image of the standard stimulus until so directed by signal from the experimenter at the close of the interval; the eyes of the observers were kept open, however. A third series had to do with the possible effects of visual stimulation during the interval between stimuli. In this series the observer noted the colors through a hooded arrangement, the colors being illuminated for two seconds by lamps, which in the interval were shut off from view by the closing of shutters; during the interval (eleven intervals ranging from two to sixty seconds) the observer attempted to hold a visual image of the color and reported its disappearance and re-appearance. Three other variations were employed, namely: *recall and selection* of slightly different colors exposed by means of the Jastrow drop apparatus; the *Burette method* of presenting a solution of a pigment which was noted and then imaged, and a weakening or a strengthening of the solution which the observer compared with his image of the previously presented color; and, lastly, the method of *direct production*, the observer attempting to reproduce a color which had been spread out on

white paper in front of him. Bentley concludes, in part, as follows, that: Grays and colors remembered in daylight tend to become lighter in the visual image. Grays presented in a dark compartment tend to become darker in the visual image during the interval of no illumination. The length of interval influences the accuracy and the lack of fidelity of visual memory; from two to six seconds no constant direction of change is noticeable, but from ten to sixty seconds there is a decrease of accuracy, and this continues to a high degree of infidelity after five minutes. But the memory image is more readily produced after five minutes than after one minute. And, where the memory *after-image* is isolated from the true memory image, the former is found to be quite constant in duration.

Somewhat as Bentley had done in the field of vision, Whipple (205), by experiments on tonal and clang discrimination and judgment, undertook to trace introspectively the nature of the tonal memory image and the qualitative changes occurring in it with the lapse of time. Standard and comparison tones, each varying in pitch in certain cases, and separated by varying time-intervals (ten and forty seconds) were given by means of the Appunn tonometer and the Stern tonvariator; the method of discrete stimuli and the method of continuous change of comparison-stimulus were employed. Six observers, students in the Psychological Laboratory at Cornell University, trained in introspection and of varying musical ability, took part in the experiments. Three observers, isolated from one another by screens, recorded on prepared sheets of paper their judgments of "equal," "greater," "less," or "doubtful,"—their certainty and their detailed introspections as to the course of their images and their processes of judging. With the continuous change method, the observer, at the point where the comparison stimulus appeared to be subjectively equal to the standard stimulus, depressed a key which automatically ended the tone at that point. The image of the standard stimulus was at times actively held throughout the interval; and at other times distractions (by odors) were

employed to effect the forgetting of the standard stimulus during the interval. The observers reacted in some cases without knowledge, and in other cases with knowledge, of the number of standard and comparison stimuli, and the direction of change (whether up or down) of the comparison stimulus. From the numerical and introspective results, the investigator found (205, *b*, p. 260) in regard to the nature and the course of the auditory tonal image, that: 1. "The auditory image proper, usually of the timbre of the stimulus and localized at the instrument, attains its maximal excellence about two seconds after the stimulus; thence, despite the active use of memorial aids, such as visualization, contraction of throat muscles, etc., it gradually wanes, suffering most in intensity, less in clearness, least in quality." At forty seconds it has almost disappeared, and at sixty seconds it is entirely gone. 2. "The image apparently *tends* to flat, but this tendency is . . . consciously resisted by most observers, so that . . . at thirty seconds or afterwards, it is more often sharp." 3. The accessory constituents of the memory complex by no means disappear with the decay of the auditory memory image; sometimes they remain after the auditory image core has completely disappeared from consciousness. 4. Practice with a particular clang-color seems to make the image more intense, clearer, and of longer duration. 5. Active holding of the image soon results in a habit of imaging, and distractions are of little avail to prevent the insistence of the image during the interval; but individuals who are not given to the use of the auditory image are relatively more able to repress it when distracted by odors.

Kuhlmann has undertaken what is by far the most extensive and intensive study and has made the most careful analyses of the memory consciousness. He employed both meaningful and meaningless materials and worked particularly in the domains of vision and audition. It was he who, in the three articles (89, 90, and 91) to which we referred on page 10 of this paper, emphasized repeatedly the need of such analyses. In his first experimental study (92), to solve the problems which he had

pointed out, Kuhlmann sought by the introspective method to determine the nature of the imagery in the recall of a given material, and to determine the nature of the memory errors and the causes which produce them. A group of meaningless visual forms, five to nine in a group, was presented only once to an observer for a period of ten minutes. Immediately, and after intervals ranging from two to ninety days, the observer recalled and drew the forms, introspecting in each case as to the nature of his imagery and the processes of recall and recognition. The forms which served as materials were of three classes,—altered familiar geometrical forms, continuous irregular curves, and several-part forms of simple and curved lines. Evidence as to the nature of the imagery was obtained from the introspections,—as to the nature of recall errors and their causes, indirectly from the objective data (reproduced drawings) which, however, were supplemented by the introspections. The observers were three fellows in psychology and one fellow in education in Clark University. These results were obtained:⁹

A. Learning

The observer alternately noted the characteristics of the material and attempted to recall them,—this recall being a means of finding the difficult details to which special attention was then given. Then two devices were employed. 1. associations (visual images of other forms, objects, etc.) were consciously sought for, in the noting, for a particular form as a whole and sometimes for parts of a whole form,—these served as aids to recall; and 2. verbal descriptions and characterizations of minute or difficult details were used as aids to the noting and also to correct the associations which were made.

B. Recall

1. *The Manner of Appearance of the Imagery.*—The visual imagery showed differences in its spontaneity and in the order of development of its parts. *a.* An indefinitely localized visual image of a form might flash up at once as a whole, clear, dis-

⁹ The schematic form of classification is largely ours.

tinct, and without alterations, and might be immediately and completely accepted as correct. *b.* A certain interval, variously filled, might succeed the recall of a position before the form appeared. *c.* The visual image of a form might slowly and sequentially develop, its elements not coming simultaneously. *d.* This gradual development might occur in the appearance of several similar images one of which might be retained as most nearly correct. *e.* The image, instead of developing gradually, might stop at certain points, and after hesitation, proceed in an acceptably correct direction. *f.* For easy forms, all the details might not be visualized before the drawing,—the visual image might come part by part or in other ways *during* the drawing. *g.* For difficult forms, the observer might resort to recognition of the already drawn details, having at the outset obtained them as best he could by visual imagery.

2. *The Use of Associations.* *a.* Any one of the associations might be recalled first, to suggest the visual image of the material. *b.* The visual image might precede the appearance of the association, in which case the association served to strengthen the visual image or to give the observer assurance. *c.* The association might leave the recognitive state unaffected, being a useless member of the recall-complex. *d.* Certain tendencies of eye or hand movements (infrequent) might synchronously appear with the visual form in the direction and order of the drawing and sometimes might precede the visual image, being regarded by the observer as real aids to recall.

3. *Factors Influencing the Character of the Recall and the Nature of the Imagery.* *a.* The nature of the form: *i.* familiar forms were approached with characteristic attitudes of ease and certainty,—the images came readily, unwaveringly, and were immediately accepted,—associations were not needed and remained in the background of consciousness, but descriptive aids were used as to alterations which had been made in the original material; *ii.* forms presenting difficulty, such as the continuous irregular curves, were approached with an opposite attitude,—associations were sought for but were hard to find,—much verbal

description was necessary for various details of the curve,—the images, which were general and schematic, might be easy and spontaneous, but the details were difficult to recall and required the use of verbal designations with frequent resort to the cognitive method,—or the visual image of the form as a whole might develop in sequential fashion, with now and then hesitation, resort to aids, and uncertainty at the difficult points of the details; iii. the several-part forms were easy as to the familiar parts included in them, but difficult as to the relations of those familiar parts, and the recalls took a character intermediate between i. and ii. *b.* The influence of repetition and of elapsed time, due to which three stages in the recalls were clearly distinguished: i. a stage of rapid dropping out of verbal characterizations as aids to recall,—a more frequent use of associations,—an average degree of certainty and an average spontaneity of visual imagery; ii. a stage in which the visual imagery shows the greatest spontaneity, coming up at once without the aid of associations or verbal cues,—the first image is frequently the correct one and, if not, correction is done in the visual image,—a strong degree of assurance accompanies the visual imagery,—oftener than not the subsidiary cues come after the visual imagery and do not affect recognition; iii. a stage of partial loss of memory,—there is a general inefficiency and lack of spontaneity of the imagery,—the image develops slowly, with much hesitancy and with periods in which no supplementary aids appear, and in wrong directions which are hardly recognized as wrong by the observer,—there is false description, and rivalry of different recall factors is manifest,—finally resort is had to the cognitive drawing method and still the observer remains uncertain of or indifferent to the final result.

4. *The Relation of Errors to Ease and Certainty of Recall.* The errors bore no regular relation to the ease or the certainty with which the observers reproduced the material. *a.* Most of the errors made in the first recall remained constant in the later recalls; *b.* some errors retained their characters but increased in degree in a constant direction; and *c.* other errors changed in character, at least not only in degree in the same direction.

5. *Sources of Error.* *a.* Ambiguous verbal characterizations frequently led to erroneous recalls. *b.* An association with the form as a whole or a definite part of it tended to result in a drawing more like itself than like the original material. And *c.* a source of error which includes five factors: *i.* certain parts of a figure, resembling certain familiar geometrical forms, are drawn like the familiar figure although the observer denies the presence of an association; *ii.* lines not quite vertical or horizontal tend to become vertical or horizontal; *iii.* parts not quite parallel or perpendicular tend to become parallel or perpendicular; *iv.* parts not quite equal tend to become equal; and *v.* there is a tendency to arrange the parts in symmetrical order.

A second study (93) by Kuhlmann differed from the foregoing mostly in the fact that here pictures of meaningful objects¹⁰ were used; there were also minor changes of procedure,—the observers recalled but did not draw the pictures,—the picture was first recalled as a whole, and after introspection by the observer the picture was recalled detail by detail. Time intervals varying between a few days, ten days, and four weeks separated the recalls of the same material. The results which were obtained were similar to the findings in the former study. With the lapse of time the learning-order which had characterized the early recalls broke up gradually, due to the factors of differences in the spontaneity of the imagery of different pictures, the special prominence of certain associations, and a general image of the square-arrangement of the pictures of a group. As in the previous experiment, the associations were shown to undergo processes of simplification in their imagery and to disappear entirely as time elapsed; when occurring previous to or synchronous with the visual image of the figures, the associations served as aids to recall and as factors in subjective assurance as to the correctness of the recall. A similar state of affairs occurred with the verbal designatory and descriptive imagery. There was a strong tendency to reconstruct details by rejecting the wrong imagery. In this process of accepting and rejecting four factors played their parts: 1. direct recognition; 2. spontaneity of the imagery;

¹⁰ For a cut of the pictures, see (93) p. 393.

3. the absence of rival imagery; and 4. inferences from what had already been recalled and from the observer's knowledge of the objects represented by the pictures. These four factors were affected by the lapse of time, in that the spontaneity of correct imagery decreased, the intensity of direct recognition decreased, and rival imagery disappeared from old places of difficulty but at times appeared at new points of difficulty. There were two general classes of alterations through which the image content passed; the first, the class in which the observer recognized the changes as incorrect but they persisted and gained in frequency with the lapse of time; and the second, the class of memory illusions, where natural colors and motions were inserted in the pictures by the observer's imagery. These illusions were due to the tendency of the imagery of the picture to change to the imagery of the object represented by the picture, which result is apparent from the following facts: the spontaneity of correct imagery declined as time went on; spontaneity, or the lack of it, was a criterion of correctness; immediate recognition decreased; the objects, and not the pictures of the objects, belonged to the observer's everyday experience, their images being readier and more habitual in appearance; more interest and emotional coloring is obtained from objects than from pictures of objects; and to the extent in which the picture truly represents the object, just to that degree is the imagery of the object already given.

Kuhlmann's third study (94) agreed in aim with his earlier studies, but here the auditory memory consciousness was investigated. The materials for learning consisted of verbal discourse and groups of sounds all presented by means of a graphophone, and each material was presented two, three, or four times at the first sitting (in two series they were repeated at later sittings); the matter was recalled immediately, or after one, four and ten weeks. Five tasks were required of the observer: 1. a semi-passive recall, in which merely the names of the various sounds were given and the order of the processes that entered into that recall; 2. introspection as to the manner in which the sounds were memorized; 3. *a detailed recall of each sound, with observations on the conscious processes and their functioning*; 4. the

observer measured the duration of each sound in his recall and recorded that judgment by a key and electro-magnet device, and introspected on the process of measurement; and 5. after the conclusion of a series with a group of sounds the observer measured the duration of each sound perceived. By this procedure it was found that the words of the verbal discourse were recalled: 1. directly in auditory imagery; 2. associatively by visual imagery of the persons or the things suggested by the heard words; and 3. by inference from the visual or verbal context already recalled. The second was the most usual method of recall, especially at the beginning of records, at turning points of the discourse, and at points of difficulty in recalling the words. The auditory imagery varied in its completeness, in the degree in which the words carried the quality of the speaker's voice, and in imagery of the speaker's voice without the words. The lapse of time had its most noticeable effect in the second recall, *i. e.*, in the recall after one week's interval; the visual imagery which previously followed or occurred simultaneously with the auditory, now preceded it and became the means of recall; the visual imagery increased in amount and in its continuity even to the extent of alone representing a whole scene or event. With lapse of time the auditory imagery showed the following progressive changes in quality: 1. the voice was imaged in its individual quality; 2. it was imaged as merely a bass or a tenor; 3. it was imaged in a characterless fashion; and 4. no definite complete auditory imagery preceded the formulation and the statement of the words of the recall. In semi-passive recalls the visual imagery showed the greatest spontaneity, next the auditory, the verbal names, and the motor processes. The visual imagery, considered from the manner in which it was employed, was of three kinds: 1. of the objects producing the sounds (most frequent),—used solely to initiate the auditory process and, if unduly attended to, hindered the recall of details; 2. of the objects going through the motions necessary for the making of the sounds,—employed to initiate the auditory process and to recall details; and 3. of arbitrary forms and colors which were signs for certain characteristics of the sounds. The verbal

processes were names of things and were never descriptions of the sounds proper, hence they were of little value in the recall of details. The motor processes in initiating the recall of sounds, were by far the most prominent factors in the recall of details, especially where a sound was recalled minutely and vividly; they were the basis and a necessary means of measuring the duration of sounds from memory. The auditory imagery was extremely fragmentary, and its course was extremely irregular, at times leaving wide gaps to be filled in by means of motor and visual processes.

Henderson's study (70) of memory followed a line of inquiry almost wholly different from that of Bentley, Whipple and Kuhlmann, but somewhat similar to the work of Philippe. With a view to showing the relation of memory for ideas to memory for words, and also to shed some light on the qualitative modifications of ideas that occur with the lapse of time, the investigator had certain passages of connected prose learned in a given time and reproduced after definite intervals,—immediately, after two days, and after four weeks. The method was that of class-room experiment by written exercise, and the papers turned in were studied as to any and all alterations which characterized the later recalls. The observers, 212 in all, included 156 school-children, 21 undergraduates, 17 summer students and 18 graduates in psychology in Columbia University. From the graduate students, who had before them a set of questions as to their mental processes, written introspections were obtained for only the third reproduction. The experimenter believed that he had established the following results relative to the nature of the recall process and to the qualitative changes occurring in the later reproductions.

I. There are three steps in the process of recall, namely: 1. a preliminary adjustment of attention similar to that employed in the learning, and accomplished by images of the learning situation; 2. a sense¹¹ of the general meaning of the passage; and

¹¹ "Sense of the general meaning" is an extremely vague expression, and we are at a loss to know just what process of consciousness is denoted by such a characterization.

3. the unfolding of the details, obtained by waiting expectantly for certain cues to lead to results, or by reasoning from the cues to the details, and testing these by the criterion of familiarity in the context.

II. There are three types of alterations through which the ideas pass in the course of time; A. a *re-grouping* of ideas or topics which are closely allied to one another, and the disappearance of contradictory or inconsistent ideas; B. a *simplification* which takes place in two manners; 1. by *condensation*, in which process (a) words are substituted for a long expression, the unimportant terms being dropped, and (b) similar ideas are placed into one expression; and 2. by *modification*, in which process there is a fusion of parts which resemble the same forbear, modified to suit a new context, or to fit the observer's past experience, or out-and-out omissions; and C. an *introduction*, in which process substitutions are made for similar ideas, and there is a spreading of similarities greater than in the original material, thus aiding the process of generalization. Re-grouping and re-simplification continue *ad infinitum* through another "giddy circle."¹²

Gordon (67), working under the conception that there are two irreducible laws of memory, namely the law of *association by contiguity* which is a mechanical and external function, and the law of *association by similarity*, which is a subjective and internal function,—sought to determine what influence is exerted by complexity of content (1) on memory and (2) on attention. In the experiment on memory, the simplest materials, nine nonsense syllables, shown one at a time through an opening in a screen, were presented for memorization, and the time required

¹²We make use of the terms "*ad infinitum*" and "giddy circle" in summarizing Henderson's conclusions because we suspect, from a schema of results so systematic and logical as his, that the logical order and system in which his results are arranged were not wholly characteristic of the introspective facts which he accumulated in his investigation; from our own introspections and from the introspections of our observers we are led to believe that the disintegration and re-assimilation of images and ideas do not progress in nearly such an orderly and regular and logically systematic manner as Henderson reported.

for learning them and for re-learning them after periods of delay was compared with the time necessary for the learning of nine other nonsense syllables which were complicated by variations in the order, location, and coloring of the syllables. The more complex series of syllables (the series containing different spatial features and colors) was more easily learned than the simpler series.¹³ To measure the effect of complexity of content on attention, a card bearing a simple and a complex figure was handed the observer who was to note only one, but either one, of the figures on the card. And, to measure the holding of attention, the observer was told to let his attention alternate between the two figures, and to linger as long as he chose on either one; the operator registered on a smoked drum the number and the duration of the observer's eye-movements.¹⁴ And, again to measure the holding of attention, the experimenter had the observer note illusion figures of the back of a book and a stair-case, pressing a rubber bulb at each fluctuation of his attention. It was found that the more complex figure attracts and holds the attention.

Finkenbinder (55) attempted to determine the mental contents which characterize remembrances of logically related data. Mathematical problems, often involving spatial relationships, and other problems, were solved by the observer; and after intervals varying from one month to five months, the observer recalled both the problem and the solution, and described his mental procedure and his mental contents. Visual images were found

¹³Gordon's paper (67) is not clear as to whether or not she employed the same series of syllables in the two cases, only adding greater complexity to the same syllables and then using them for the second series; obviously, if the same syllables were re-presented with greater complexity of details the oldness of the syllables and familiarity with them and their partially learned characteristics would in no small degree account for their being more easily learned in series two than in series one. However, we must give the investigator the benefit of the doubt and believe that not the same syllables were re-presented for learning in series two.

¹⁴This was an unreliable procedure, to say the least, for, were the recording on the smoked drum accurately and mechanically done by means of electro-magnets or Marie tambours, still the personal-equation, the perception- and reaction-times of the experimenter, in his perceiving the eye-movements of his observer and in his then reacting himself to register a record on the drum, are sufficient causes of error and inaccuracy.

to constitute ninety per cent. of the total contents of the remembrances of eighteen observers, although various kinds of imagery had attended the original understanding and solving of the problems. Problems having to do with turns of language, however, tended to be recalled in auditory, vocal-motor and visual verbal imagery. The imagery first appearing in a recall was vague and schematic,—but later it became more definite and detailed;—its stability and non-conflicting character was an essential factor in subjective assurance of correctness. Various processes of solving which had earlier been employed were most frequently forgotten after a month or more. It is just to say of this study that its scope was too narrow; that it was confined almost wholly to a conception of images as static; and that it seemed to show a predilection in favor of visual imagery.¹⁵

Slaughter (166) sought to ascertain the exact behavior of the image in a certain interval of time. The observer was allowed to look at a drawn figure on a card for a few seconds before a "ready" signal was given (this signal ushered in a period of time during which it was hoped the after-image would be lost), and after five seconds the experimenter signalled "now" for the observer to note his image of the diagram for a period of ten seconds, at the close of which another "now" concluded the observation. Then an introspection as to the behavior of the image was reported by the observer. The movements which the investigator wished his observers to image were represented by drawings on cards. Auditory, tactual, gustatory and olfactory images were to be initiated by the experimenter's giving of a call-word. It was believed that the following results were estab-

¹⁵ It goes without saying, and there is ample evidence to show that, all else being equal, visual imagery is the best mode of recalling spatial relations, because visual imagery offers a simultaneous representation which is needed in dealing with spatial problems. But it is just the "all else *not* being equal" that throws difficulty in the way of this study,—it is just the *logical* side of memory which this study seems to neglect. In a word, the investigator took slight account of the *process* characters of the mental contents which he undertook to investigate; he missed almost entirely those subtle and intricate and fleeting variations in focality, in intensity, and in spatial and temporal duration which seem to be extremely important factors in all higher-thought processes.

lished: 1. the factors which hold visual images in clear consciousness are their own internal organization together with motor elements; 2. auditory images appear only in associative complexes, where motor elements are prominent; and 3. other images (tactual, gustatory, etc.) also require associative complexes, and even here the existence of such images is doubtful. It must be said of Slaughter's study that it is of doubtful validity,¹⁶ for the data were insufficient in amount and in quality, the method was poor, the conditions of experimentation were dissimilar, the introspections in some cases were ignored, and very little was said of the *behavior*, or the *process* aspects, of the images studied.

Meakin (110) attempted an investigation of the inhibitory force of one image on another; the study, however, amounted to little more than furnishing indications of the fact that size, complexity, form, and color of figures are incentives to revival,¹⁷ images of the more complex figure, of the figure with more irregular lines, of the moderately large figure, and of the black (as against the grey) figure, are all prone to recur and to persist in consciousness. Moore (122) had his observers note their memory images of simple figures, to suppress images of certain figures, and to move and alter (in color, etc.,) images of certain other figures; the time required for these operations was recorded. In the suppression of images, and in the moving of images (to other localizations), eye-movements played an important rôle. Under passive observation images suffered a very noticeable fading in color and a loss of definite outline. In the early recalls, the objects were imaged in the places of the original presentation. Vocal-motor and auditory imagery furnished important initiatory cues for the arousal of images of color. Murray (129), in a more carefully planned and more systematic investigation than those of Meakin and Moore, studied the spontaneous recurrence and persistence of images of different figures. In general, she found that neither the attributes of quality and spatial localization of a stimulus, nor ocular movements incident

¹⁶ Lay (97) has severely criticized the work.

¹⁷ Bentley (24) reviews and criticizes Meakin's study.

to sense impressions of that stimulus, constitute the important factors which determine visual recall. On the contrary, re-appearance and persistence, and distinctness and accuracy, of a recall-image are conditioned by the relation of the image to certain central (subjective or apperceptive) conditions.¹⁸

Experimental studies by Perky (139), Martin (106), and Ogden (133), have attempted (and, in our opinion, without avail) to determine what are the characteristic differences between memory images and images of imagination. Each of these investigators has, on the basis of introspective data, sought to point out certain characteristic and invariable factors which are thought to be inherent in the processes in question. The most patent fault of all of these studies lies in the fact that the investigators started with the assumption that there are pure images of memory and pure images of imagination, the one being distinct from the other;¹⁹ and on that basis the investigators proceeded to institute a comparison between such images as were supposed to be of the two kinds mentioned, namely memory and imagination. Furthermore, images of memory and of imagination were thought to be simple in function; that images could possibly undergo the greatest complexity in their manifestations and in their *process* characters received only slight consideration at the hands of these investigators. Perky employed a rather questionable method. Lantern pictures of certain objects were presented in perceptual terms to the observer, who was supposed to be totally unaware that the pictures were being perceptually presented,—he was to “image” a certain object in the localization of the lantern picture. The purpose of this procedure was to determine just what are the characteristic marks of an image which serve to differentiate it from perception. Martin’s method also was not above reproach. She required of not only her best trained introspectors but also of naïve subjects that they call up

¹⁸ In our own experimental results we shall attempt to throw light upon these “central conditions,” or at least upon one *central* factor which plays an important part in the phenomena of recurrence and persistence.

¹⁹ See Clark (41, p. 488 ff.) whose investigation is reviewed in this paper (p. 28 f.).

and manipulate two simultaneous visual images; they were to project the images to certain localities, and to alter their images in certain other ways. This was a spurious bit of experimenting, for the most skilled and most practiced introspectors find it an extremely difficult task to report on the variations in quality, intensity, focality, and duration of even a single visual image. Moreover, one can see in some of the images evoked by Martin's subjects little more in the nature of imagination than the mere fact that the experimenter asked her observers to "imagine" such and such an object in such and such a place. Ogden failed to throw much light on the problem. Unable to find in consciousness criteria for differentiating memory from imagination, he goes outside of consciousness and makes a very ready resort to the use of the supposed imageless contents and of the supposed thought-element. In our own experimental results we hope to show at least something as to really how very complex images of memory and imagination are, and, in this way, to furnish indications relating to the problem of the differences between memory images and images of imagination.

Our own investigation, reported in the pages of this paper, was begun at Clark University in the autumn of 1914 and was continued until June, 1916. In November, 1916, just when our report was being re-written and prepared for publication, there appeared a study somewhat similar to ours, having to do with the visual image and attention, by Clark (41). This investigator attempted (1) to classify images as being familiar, unfamiliar, and general; (2) to ascertain the relation between kind and function of image with ocular movement; and (3) to discover as many functions of the image as possible, such functions for instance as particularity, familiarity, location and position of image, imaginal background, size of image, stability, clearness relations, color, affection, bodily reference, temporal localization, and various contexts of the image. Both introspective and objective methods of experimentation, some of them extremely ingenious, were employed. The investigator found that her familiar-images agreed in character with the memory-images of

both Perky and Ogden, and with the individual images of Koffka (85); that her unfamiliar-images were similar to the imagination-images of Ogden, and the individual-images of Koffka; and that her general- or generic-images were similar to the imagination-images of Perky, and to the general-images of Koffka. Clark's general- or generic-images, instead of being similar to Perky's images of imagination in being "substantial" and "complete," were schematic and vague. Martin and Ogden were confirmed in the discovery that no relation existed between kind of image and the presence or absence of color. Both Clark and Ogden failed to substantiate the existence of Perky's memorial "mood of recognition" or her imaginative "mood of surprise." Clark's study brought to light no characteristic relation between kind of image and its stability as regards memory and imagination. "The conditions of ocular movement with imagery seem to be general conditions,—not the conditions which distinguish two imaginal functions, memorial and imaginative. Indeed, it is doubtful whether it is feasible and proper to attempt to oppose these two functions at the level of the total image. Our own analyses" . . . "suggest a very large number of functional gradations for the simpler imaginal complexes;—gradations of specifying, of individualizing, of generalizing, of symbolizing (see p. 44 ff., this thesis), and of references to the observer, to objects, to times, to places, and to contexts." (P. 490).

III. OUR EXPERIMENT

A. PROCEDURE

i. *Aims*

This study concerns itself with an experimental investigation of the qualitative changes which images undergo during the lapse of time,—and also with alterations and mutilations occurring in retained and recalled memorial contents after various time intervals. A piece of meaningful material was presented for learning, and was recalled immediately after the learning; from then on delayed recalls were had after various intervals of time, ranging from thirty minutes to over three hundred days. From introspective cross-sections of the processes of consciousness manifested in the procedures of learning and recalling, we have aimed to work out the telescopic and transitional forms induced by forgetting and by the lapse of time. We have also sought to compare the recalled contents, that is the remembered materials, to ascertain what effects were produced in them in the course of forgetting. The aim has been an intensive rather than an extensive attack of the problem,—our main avenue of approach to this problem being by the method of careful, detailed introspective analyses of the memory consciousness; and as a subsidiary device of study we have instituted a comparison between the reproductions after the various intervals of delay, in an attempt to discover just what are the effects of forgetting manifested in the objective recalled contents themselves.

ii. *Apparatus*

Seven series of learning materials were employed. Series I and CI consisted of pictures, cut from newspapers, representing football players and boxers in certain characteristic postures. These pictures were mounted on grey, black, or white cards, of varying sizes from 40 cm. x 35 cm. to 26 cm. x 18 cm. The pictures themselves ranged in size from 37 cm. x 25 cm. to 20 cm.

x 12 cm. Series II consisted of cards bearing geometrical diagrams, nonsense drawings, and various colors arranged in different forms; the sizes of the different cards varied from 28 cm. square to 38 cm. x 28 cm. Series III consisted of comic newspaper pictures ("Pa Van Loon" and "Bringing-Up Father"), the former colored and the latter uncolored; these were mounted on black and white cards. Series IV consisted of selections of philosophical prose, written by hand or typewritten on cards and library slips; details of color, capital letters, hyphens and underlinings were inserted as parts of the material. Series V consisted of an artist's undraped wooden mannikin, 91 cm. in height, presented in certain well-known postures.¹ Series B consisted of a clay object,² shaped somewhat like an outer ear, 8 cm. on its longer axis and 5 cm. on its shorter axis, and bearing on its convex surface a ridge in which two metal hooks or eyes were inserted, and a piece of burlap glued near the ridge. Series I, III, and V were designed for the purpose of studying all possible forms of kinaesthesia or empathic experiences, and any possible trace of affection which might have attended the original presentation of the material. Series CI consisted of athletic pictures (football players and boxers) as nearly similar as we could find them; materials C I 7, C I 6, C I 5, C I 4, and C I 3 were recalled immediately and after 7, 14, 21, 28 and 35 days respectively. The effort was made to avoid the possibly evil effects of *repeated* recalls of the same material; hence, the time intervals of 7, 14, 21, 28, and 35 days were employed with the different but similar learning materials of Series CI.

All the materials, except Series B, were presented to the observer in visual fashion; Series B was presented in a tactual and kinaesthetic manner,—the observer was blindfolded and was allowed to handle the object. The cards of Series I, II, III and CI were fastened by means of thumbtacks to an upright screen built

¹ The postures of "An Orator," with right hand extended in gesture, and of a "Gymnast," balancing on one leg and lowering his body to the floor.

² Designed by Dr. S. C. Fisher in her experiment on Abstraction (57).

on to an ordinary small table; the surface of this upright screen and the top of the table were uniformly covered with green cardboard. The presented card was on a line horizontal with the observer's eyes at a distance of 61 cm. as he sat before the table. A falling shutter screened the card from view; this shutter was 40 cm. square, and covered the card until the experimenter made the presentation by raising the shutter. The experimenter stood out of the observer's field of vision at his left. The materials of Series IV were handed the observer, or they were tacked on the top of the table just in front of him,—in the latter case, a card screened the material from view until the experimenter gave the "ready" signal and displayed the material for presentation. The artist's mannikin (of Series V) was presented on the top of an ordinary table against a white background, and was enclosed by curtains operated by means of pulleys and ropes from the observer's rear. The observer sat facing the mannikin at a distance of 214 cm. Most of the materials³ bore in printed form captions by means of which they were recalled after various periods of delay. In Series II 1, 3, IV 2 the captions (such as "lettered squares," "color circle," and "philosophical prose") were presented to the observer in auditory fashion. The captions, in the majority of cases, were roughly characteristic of the presented materials, although it was our purpose not to make the caption exactly representative of the material with which it was associated; there were two reasons for this procedure,—first, in order that the caption would not too easily of itself give a clue to the details of the material to be recalled; and, second, in order to ascertain whether or not the observer would remember his various remarks and judgments concerning the relation existing between the caption and its accompanying material.

iii. *Methods*

The experimenter before the learning experiment began gave the following instructions: "To-day you will be presented some material to be learned,—use any learning procedure you like or

³ The exceptions were Series II 1, 3, and IV 2.

find easiest of employment; thirty seconds will be allowed for the learning, at the conclusion of which time the experimenter will end the exposure;⁴ then you will recall⁵ and then give as complete and as detailed an introspective description as possible of the procedure which you employed in learning and in recall." The observer's time of recall was limited only by his statement that his recall was completed.

The observer made frequent delayed recalls after the original learning; these recalls came at intervals of varying lengths after the learning, ranging from thirty minutes to over three hundred days. The time intervals are given in Table I, page 34, and Table II, page 36, gives the number of recalls, both immediate and delayed, of each material and for each observer.

The materials were presented only once to an observer for learning, and he never again saw them or came directly in contact with them in the course of the investigation.⁶ Every material was recalled immediately after the completion of the thirty seconds' learning. Before the delayed recall experiment began, the experimenter gave the following instructions: "To-day the experimenter will ask you to recall a certain material; will you recall that material to yourself silently and then express⁷ that recall and then introspect on the processes of consciousness entering into that recall?" The experimenter gave a "ready" signal and then called out to the observer the caption of a certain material.

iv. *Observers*

Our ten observers were all highly trained in introspection; they were individuals of considerable introspective experience varying from one year's to five years' practice. The ten observers, all instructors or graduate students of Experimental

⁴ By dropping the shutter, or removing the material, or closing the curtains, as the case might have been.

⁵ Orally in Series III, IV, B, and CI; orally and by drawing in Series I and V; and by drawing in Series II.

⁶ Except in the case of the artist's mannikin, which was re-adjusted to other postures for the different presentations to an observer.

⁷ Orally, or orally and by drawing, or by drawing alone, as the case might have been,—see footnote 5, above.

TABLE I

This table shows the various temporal intervals, expressed in minutes (') and in days, which elapsed between presentation and recall in the various experiments. All materials were recalled immediately after presentation; but the immediate recalls are not included in this table.

Observers Materials (series)	B	F	Fg	Fs	H	O	R	S	T	W
I 1	7 28 82 110	30' 7 21 35 70 419	21 49 70 76 100	30' 7 94	17 32 79 110	30' 7 21 70 425	21 59 112	30' 14 84	30' 23 42 49 305	30' 7 70
I 2		7 14 35 258				13 14 49 111			11 18 21 38 46 105	
II 1	33 47 77 84	49 70 98 314		4 11 18		21 49 80 108 320				
II 2		12 21 54 89				13 14 49 111			10 21 49 73	
II 3	7 21 84 112	30' 7 21 28	7 21 42 49	7 52 73	7 21 118 208	4 11 42 67	14 56 88	14 42	30' 7 7 189	
		56 323 356				95 381				
III 1	7 14 19 26 56 131	21 56 70 77 84 323	11 21 105 110 140	11 28 35	21 73 90 174	24 63 94 334	14 56 73		12 19 60 285	
III 2	16 42 72 98	9 14 28 35 77 119				4 25 28 255			4 7 21 49 67 105	

TABLE I—Continued

Observers Materials (series)	<i>B</i>	<i>F</i>	<i>F_g</i>	<i>F_s</i>	<i>H</i>	<i>O</i>	<i>R</i>	<i>S</i>	<i>T</i>	<i>W</i>
IV 1	2	30'	3	14		30'	11	7	4	30'
	30	7	10	21		4	14		7	7
	93	21	80	107		7	25		11	70
		63	115			14	63		14	
		98				74			18	
		407				422			63	
									137	
IV 2		5				1			3	
		7				14			13	
		19				28			31	
		26				29			59	
		28				77				
		96				126				
IV 3		42		3	20	24				
		328			69	42				
					167	329				
					177					
V 1	7	30'	35	7		14	4	7	3	4
	37	7	49	56		21	7		7	
	63	35	70	73		56	18		28	
	84	42	86			172	46		31	
		49				394			35	
		372							126	
V 2		2		3	16	3			3	
		21		7	34	7			7	
		28		10	79	21			28	
		63			93	38			31	
		84				45			35	
						273			126	
B 1		7				28				
		35				69				
		56				91				
CI 3	35	35				35			35	
		78				85				
CI 4	28	28				28			28	
		77				84				
CI 5	21	21				21			21	
		72				78				
CI 6	14	14				14			14	
		63				70				
CI 7	7	7				7			7	
		65				71				

TABLE II

This table shows the total number of learnings, the number of recalls of each material, the number of introspections by every observer, and the number and the percentages of introspections quoted.

Observers Materials (series)	<i>B</i>	<i>F</i>	<i>Fg</i>	<i>Fs</i>	<i>H</i>	<i>O</i>	<i>R</i>	<i>S</i>	<i>T</i>	<i>W</i>	Total
I 1	5	7	6	4	5	6	4	4	6	4	51
2		5				6			7		18
II 1	5	5		4		6					20
2		5				5			5		15
3	5	8	5	4	5	7	4	3	5		46
III 1	7	7	6	4	5	5	4		5		43
2	5	7				5			7		24
IV 1	4	7	5	4		7	5	2	8	3	45
2		7				7			5		19
3		3		2	5	4					14
V 1	5	7	5	4		6	5	2	7	2	43
2		6		4	5	7			5		27
B 1		4					4				8
CI 3	2	3				3			2		10
4	2	3				3			2		10
5	2	3				3			2		10
6	2	3				3			2		10
7	2	3				3			2		10
Total Number of Recalls	46	93	27	30	25	90	22	11	70	9	423
Total Number of Learnings	12	18	5	8	5	18	5	4	15	3	93
Total Number of In- trospections Taken	58	111	32	38	30	108	27	15	85	12	516
Number of Intro- spections Quoted	14	12	14	12	5	11	8	10	13	6	105
Per Cent. of Intro- spections Quoted	24.1	10.8	43.8	31.6	16.7	10.2	29.6	66.7	15.3	50.0	20.4

Psychology, were the following: Samuel W. Fernberger, Ph.D. (*F.*); Gustav A. Feingold, Ph.D. (*Fg.*); S. Carolyn Fisher, Ph.D. (*Fs.*); Ethel Bowman, A.M. (*B.*); Baiten Hori, A.M. (*H.*); Francis J. O'Brien, A.M. (*O.*); Bruce B. Robinson, A.B. (*R.*); George S. Snoddy, A.M. (*S.*); Robert B. Teachout, A.M. (*T.*); and Raymond H. Wheeler, A.M. (*W.*). It is a pleasure to express our gratitude to Professor J. W. Baird,⁸ who sug-

⁸ This manuscript, in its original, rough draft, was approved by Professor Baird during the spring semester of 1916; the revised and amended and

gested this investigation and who has generously supervised it, and to our observers who have furnished us with introspective data extremely difficult to obtain and upon which our main results are based.

B. RESULTS

i. *The Observers' Methods of Learning the Material*

Before considering the nature of the imagery in the recalls and the qualitative aspects of the imagery as affected by time and by forgetting, we must first consider the processes of consciousness which attended the original presentation and the learning of the material. This will throw light upon the observer's type of learning and upon his ideational type as well, and upon the nature of the processes of consciousness and other sorts of processes in question which may or may not be affected by the lapse of time.

The observers rarely ever attempted during the acts of learning to recall details or the whole of the material before them.⁹ The whole period of learning was spent in active, attentive noting, which was desired in the employment of a learning-period of thirty seconds and which was influenced by the instructions. Neither over-learning nor the entrance of extraneous and more or less subsidiary processes and procedures was desired in the experiment. It was aimed to maintain the subjective conditions as constant as possible, hence a short learning-period of thirty seconds was employed, and instructions were given to induce active learning. Only in a few cases did the presented material produce affective and emotional reactions in the observer. In using football and other athletic pictures and ob-

final draft was accepted by him in September, 1917, and was in his possession at the time of his untimely death in February, 1919; and the third, re-edited, and amplified draft has been prepared for publication during the summer and autumn of 1919, following very helpful criticisms and suggestions given by Dr. S. W. Fernberger, to whom we acknowledge our indebtedness.

⁹ Kuhlmann's observers did make trial recalls; but his learning-period was 10 minutes long, whereas in our own experiment only 30 seconds were allowed for learning. See (92, p. 319) and this paper, p. 15 ff.

jects, and comic pictures, we had hoped to arouse experiences of pleasantness and unpleasantness in our observers, in order to trace genetically the "generic" feeling which Ambrowski (2, 3, and 4) has so much emphasized. What affective reactions resulted were in the nature of attitudes of surprise, amusement, excitement, wonder, awe, dismay, delight, disappointment, and disgust. They were attitudes composed of various components,¹⁰—affection seldom functioned alone, without being a member of a complex, as a "generic" feeling. Just mere pleasantness, or mere unpleasantness, when occurring in its own right, seldom had to do with the emotional characteristics of the presented material;—it had to do more with the difficulty, or the ease, of perceiving and understanding the material.

Now we are in position to inquire what were the processes of consciousness in function which we have already characterized as the active, attentive noting of the material. First of all, the observer listened intently to the experimenter's instructions. Then he assumed what may be called a "learning attitude": he settled down in his chair and faced the place of presentation, or perhaps leaned toward it; he intently fixated a point or region where the material would appear, oftentimes with eye kinaesthesia of fixation with strains and tensions, frequently with general bodily tensions and strains and frowning, etc. Very often he attempted to anticipate what material would appear; these anticipations took various forms, such as visual concrete imagery, auditory-vocal-motor and visual verbal imagery of the names, the captions, and descriptions of the material, or kinaesthetic imagery of drawing, writing or tracing the material, or kinaesthetic imagery of assuming the posture represented by the material. Often the observer repeated the instructions in vocal-motor-auditory terms. A few introspections will illustrate the point. The introspections which are quoted here refer only to the foreperiod,—the period which intervened between the presenting of the instructions and the presenting of the material

¹⁰ These components we shall discuss when we come to consider the analyses of *Bewusstseinslagen* and the effects of time upon them, Section III B iv a, beginning on pp. 93 and 94.

to be observed. The parentheses within the introspection indicate additions made by the experimenter, in an effort to make the introspection as intelligible as possible, especially as regards descriptions of learning and recall materials.

Obs. B. Series I 1. Presented November 12, 1915. "In the foreperiod I experienced strains in the eyes, forehead, back of neck, and shoulders,—a suspension of breathing, and slight unpleasantness; the shutter was in the focus of visual perception. All this meant for me interest and attention; and I repeated in auditory-vocal-motor imagery the instructions 'all you can—thirty seconds.'"

Obs. F. Series II 1. Presented March 2, 1915. "In the foreperiod I had no perceptions, as far as I am now aware; but I did experience strains in brow, eyes, jaw, neck, and upper chest; was not aware of any disturbance of breathing; close visual attention to the shutter."

Obs. Fg. Series II 3. Presented January 18, 1916. "In the foreperiod there were visual images of the caption 'Rubes de Gink' (a picture showing the four persons of the 'Bringing-Up Father' cartoons), and then a visual image of the newspaper clipping itself."

Obs. Fs. Series III 1. Presented April 17, 1915. "In the foreperiod there was a relatively non-focal kinaesthesia and organaesthesia of bodily adjustment to the apparatus; auditory perception of the experimenter's instructions; fleeting and indistinct and non-focal occasional visual images of fragments of that circle material (a circular area divided into colored segments and sectors);—all of which processes gave way just before the exposure was made to a visual perception of the shutter,—this visual perception persisted,—this was a waiting for the exposure to be made."

Obs. H. Series III 1. Presented November 21, 1915. "In the foreperiod I was passive although I expected verbal material; there were vocal-motor auditory images of 'some English sentences' and vague visual images of type-written sentences; scrappy visual and vocal-motor-auditory images of the sentence shown me last time; I experienced strains in head, upper chest, and especially through my arms; breathing was almost inhibited but I was fairly comfortable when I fixated the shutter."

Obs. O. Series III 2. Presented May 10, 1915. "In the foreperiod attention to the instructions, and my visual line of regard was highly concentrated on the shutter; a vague visual image of a brown statue (the wooden mannikin), with slight kinaesthesia of my eyes moving in the direction of the corner of the room, where the statue was located, focally present for a brief instant; a very indefinite visual image of the color circle; these two visual images alternated and fluctuated in consciousness until the experimenter presented the learning material."

Obs. R. Series IV 1. Presented March 18, 1915. "In the foreperiod after the experimenter's instructions, my attention was highly concentrated

on the table in front of me; intensive bodily tension, although I was fairly comfortable; there was no consciousness that I could not learn the material; vague visual images of the curtain and table in the corner of the room (for the mannikin), and also visual images of the white covering cardboard in front of me (concealing the learning material to be presented) with nine squares on it; vocal-motor-auditory images 'but the experimenter said that it would be presented under the cardboard'; and my attention turned to a visual image of the card with its thumbtacks; then came a vague visual image of a colored circle."

Obs. S. Series V 1. Presented January 7, 1915. "In the foreperiod I anticipated in visual images a chair sitting up there on the table (behind the mannikin curtains) and containing some cards bearing geometrical diagrams; general bodily strain and tension of expectancy."

Obs. T. Series CI 3. Presented January 10, 1916. "In the foreperiod I sat down in the chair and faced the curtain; there was no anticipation of any particular material; there was only a fixation of visual attention upon the curtain."

Obs. W. Series V 1. Presented January 12, 1915. "In the foreperiod there was a high concentration of attention, visual and general kinaesthetic, toward the curtain, with pleasantness and kinaesthesia of amusement; various visual images of objects, charts, scarecrows, etc.; kinaesthetic tension in shoulders, neck, and forehead, accompanied these visual images and vocal-motor-auditory images representing the various objects which I was visualizing."

The foregoing introspections show that every observer assumed a typical attitude of preparing to learn the material upon its presentation by the experimenter; this attitude we call the "learning attitude." It followed the reception of the instructions by the observer, and it both preceded and initiated the act of learning the presented material. This "learning attitude" consisted mainly of some form of kinaesthesia of adjustment to the place of presentation and adjustment to anticipatory images of various kinds, such as visual concrete images, visual and vocal-motor-auditory verbal images, and kinaesthetic imagery of assuming the posture represented by the anticipated material or of tracing the anticipated material by means of manual or ocular movements. This "attitude" was frequently manifested in the observer's repeating to himself the instructions given by the experimenter.

The presentation having been made, the observer visually perceived the material perhaps in a vague and obscure general

fashion at first. Intensive strains and tensions, oftentimes extending over the whole body, and sometimes pleasantness or unpleasantness, accompanied the rather general indefinite perception. Then certain details of the material began to stand out in a fairly focal manner. At this point, there infrequently occurred such emotional reactions as we have described as surprise, amusement, excitement, wonder, awe, dismay, delight, disappointment, and disgust. Two other factors entered to further complicate the experience: first, rather spontaneous and somewhat automatic appearances of vocal-motor-auditory verbal images of naming and describing the material and of making various remarks about it. By automatic we mean that the observer did not consciously or intentionally seek for associative and descriptive and characteristic terms. This imagery doubtless owed its origin to the observer's previous experiences with the same or similar materials, where he had described or labelled certain of its features. Such processes entered very spontaneously and rapidly, and did not receive a very high degree of focality of attention. Second, there began a stage in which perception wandered in aimless and disconnected fashion over details and different parts of the presented material. Most often there was no consciousness of eye or head or neck kinaesthesia; at times, however, such processes did enter the experience. The clearness or focality relations of the details perceived in visual fashion seemed to usurp or to dominate consciousness to such an extent that the kinaesthesia involved in visual noting played a very insignificant and infrequent part. In other words, the observer was seldom aware of eye kinaesthesia while he noted the presented material; his consciousness was absorbed by or concentrated on the clearness values of visual perception rather than on the eye movements incident to that visual perception. We may here state that every observer in the learning and noting of any material made frequent use of vocal-motor-auditory imagery. This imagery was at times purely associative in character, *i. e.*, the details called up more or less remote associations of other scenes, other materials, etc.; at other times it was merely

descriptive in nature, the observer minutely describing the details of the material before him. The spontaneous and rather rapid use of auditory-vocal-motor imagery by every observer in practically every learning experiment seems to warrant the conclusion that vocal-motor-auditory imagery, both descriptive and associative, is a very important factor in the understanding and the learning of materials such as were employed in this investigation. But, as regards the focality or the clearness of such processes in the sum total of the conscious processes of any one moment of the noting experience, we found an interesting state of affairs. Although great quantities of vocal-motor-auditory imagery attended the noting experience, this imagery was, generally speaking, much less clear and less focal than the phases of the visual perception itself; that is, the visually perceived details of the material seemed to possess a much greater degree of clearness than did the details in auditory-vocal-motor imagery. Visual perception, considered in this light, was much more simultaneous in character than were the images which played worthy rôles in the noting experience; vocal-motor-auditory images were successive in character. Visual perception was less mechanized than was the flow of vocal-motor-auditory images and hence received a much greater degree of attention. Being more mechanized, the flow of vocal-motor-auditory images moved much more spontaneously in the *one* line or the *one* direction of its *succession* of images. In its greater degree of clearness,—in the longer duration of its clearness,—and even in its very numerous slight shifts of clearness values, visual perception may be described here as a dominating consciousness. The characteristic features of this dominance of consciousness were the clearness, the persistence of a certain degree of clearness, and very facile and numerous shifts of clearness. Observer *F.* made the most frequent and active use of verbal characterizations. Observer *B.*, on the other hand, reported the most frequent presence of visual perception as a procedure of learning; this procedure of just perceiving, or of "looking intently," included of course many and varied changes of the clearness relations of the

details of a material to be learned. This does not deny the fact that every observer perceived the material presented for learning, for otherwise the material could not have been noted. The statement, that one observer relied less than the other observer upon visual perception alone, means that the one observer spent more time, more attention and more effort trying to name and to describe details in verbal terms than did the other observer. Whereas the other observer spent more time, more attention, and more effort in visually perceiving and re-perceiving the details of the material. An observer's time is limited,—his attention is also limited; he must perceive the entire material and then re-perceive it, thus giving a maximum expenditure of effort in perception, or he must perceive a small part of the material, or he must perceive the whole of the material in a general and indefinite fashion, and then he must resort to subsidiary devices of learning, such as verbal naming and describing, etc. It is in this light that we have characterized Observer *F.* as a verbal learner, and Observer *B.* as a visual perceptual learner. The other observers ranged in between these two extremes. *Fs.*, *W.*, *R.*, and *H.* tended toward the visual perceptual end of the noting scale; whereas *O.*, *S.*, *Fg.*, and *T.* leaned toward a verbal noting procedure.

Every observer at some time or other made use of kinaesthesia as a process of learning. This kinaesthetic procedure consisted of two types or classes. First, there was a tracing of the lines or the directions of the lines or the various shapes comprising the presented material. This tracing took various forms, and every observer was at times accustomed to employ one or another form. The forms varied from general bodily kinaesthesia of leaning in the direction indicated by the material, and from hand, eye, neck, and head kinaesthesia of locating and of drawing and tracing, to tongue and lip kinaesthesia. Observers *F.*, *T.*, *S.*, and *O.* made the most frequent use of such methods of learning; *F.* and *T.* employed these forms of kinaesthesia to a very large extent.

Every observer at times experienced during the learning act

certain processes which we term empathic. The observer assumed (not intentionally or in consequence of an *Aufgabe*) the kinaesthetic attitude represented by the figure (such as the football postures in Series I and CI, the familiar attitudes represented by the mannikin in Series V, and the comic attitudes represented in Series III. These empathic attitudes were complexes.¹¹ They were usually complexes composed of various elements of general bodily kinaesthesia, but frequently the complexes included both affective and organic, and even visual imaginal, components. The kinaesthesia in the part of the body corresponding more particularly with the movement represented in the learning material, such as an extended leg or raised arm or winking eye, was more focal and more intense in consciousness. One striking feature of such empathic complexes was their rather sudden and rapid and focal manner of appearing; they came instantaneously, and frequently disappeared in a like manner. Another striking characteristic was their composite and yet somewhat unitary nature. Various components or elements were involved, but these components seemed to be all simultaneous, and they differed but little in degree of clearness. The task of introspectively analyzing out the various components was an extremely difficult one for the observer, and at best his description was only a rough characterization.

As already indicated, the observer's visual perception of the material during the first moment of the presentation was usually of a hazy and general sort. A clearer and more definite but less general perception followed. In the second stage of this perceiving process, certain features tended to stand out more prominently than other features; the material was typified into a clear, unitary perception, just as happens when one attends intently to just the face of a full length photograph; some features of the

¹¹By the term "complex" we shall mean any group of processes of consciousness which have come to function together in a unity,—in simultaneous or near-simultaneous fashion. A complex may be extremely rich in content and may be comprised of the most manifold constituent processes; or it may possess only a few elements, which may or may not be extremely mechanized in function. We shall not mean by "complex" the Freudian constellation of emotionally-toned ideas around a sex core.

face seem to become extremely clear and to advance out of the plane in which they really are toward the observer, while other features recede and wholly disappear from the visual perception of the picture. To express it in diagrammatic terms,—the focal feature would be the apex of a cone extending toward the observer, while the features of less and less great clearness would be the curved surface of the cone extending in order of less clearness toward the cone's base; the most outlying and the least clear details would comprise the base of the cone. The details appearing in this total, unitary, clear perception were the details most essential to the integrity¹² of the particular feature in question represented by the material, for instance the details representing a kick in the picture entitled "Kick-Off."

Obs. F. Series C I 4. Presented November 17, 1915. "The shutter was raised, and I had an *instantaneous visual perception of the figure as a whole*, and vocal-motor images of 'football player.' This seemed the immediate antecedent of a partial release of strains." . . . "The motor image of myself being in the position occupied by the player persisted but became much less focal in consciousness. My visual fixation, *with a clear visual perception of the player's head and his face, held on the details of the player, and the position of his lips attracted my attention*, and there came the vocal-motor images of the words, 'that's funny—must have hurt him—similar to one's lips when one has the wind knocked out of one—it hurts' . . ."

Obs. F. Series III 2. Presented October 4, 1915. "There was first a very rapid visual perception of the central figure. Attention then went to the card-board caption above the figure and I read the caption in visual perceptual terms and by means of accompanying vocal-motor-auditory imagery of such descriptive terms as 'Poker Shark.' Then came a rapid fixation of and turn of attention to the picture and a *more concentrated attention* to the details of the picture,—*i. e., the field of attention was very much narrowed*. I noted in visual perceptual terms the details which later I recalled. Then came a rapid shift of attention to the upper, caption, card and again my visual perceptual attention was much more concentrated and narrowed during the examination of the details of the caption-card."

¹² In discussing the effects of old associations, or as he calls them, *interests*, in selecting details to be attended to in observational learning and to be retained and subsequently reproduced, Meumann (115, p. 136 f.) speaks of details and associations which are of no practical use in the world to a learner except that they are essential to the integrity of the dominant meaning of a presented material, such as a picture, and which are conducive not only to an understanding but also to a remembering of the picture as a whole.

Obs. O. Series III 2. Presented May 10, 1915. ". . . My visual line of regard fell on the title; and then on the hearts, diamonds, spades, and clubs, seen almost in one glance, and then visual regard fell on first the title, then in order on hearts, diamonds, spades, and clubs, each becoming more focal as my visual regard focused on it."

With these essential details, there were rapid, though continuous and unbroken, shifts of focal relations. In such shifts, the detail attended to stood out in an extreme degree of clearness, making its focal relation apparent at once; and a gradual and unbroken lessening of clearness marked the details extending out toward the periphery of the concatenations of focal relations. Shifts to the detail of the more outlying regions of the material, that is, the successive changes of focality, were rather precipitous, jerky, and broken in character. In these shifts to the farther outlying regions of the material, the detail which had just been focal disappeared completely from consciousness in a rather sudden manner. The more broken, discontinuous, sudden, and jerky shifts of focality, in perceiving, occurred with details less essential to the meaning of the presented material as a whole. Gross examples of these details were the captions (the titles of the different materials), interpolations of colors in the material by the experimenter, sizes of materials, how mounted, etc. If the material constituted a coherent whole, for example, the picture of a man, the observer usually noted it in a continuous, gradual, though moving, fashion, from head down to feet, or from feet up to head. However, in later surveys of the material in the course of the same learning or noting, the details were very frequently noted in a random, haphazard fashion; in this procedure, difficult details and details in nature more or less unessential, were emphasized and dwelt upon at length and with the employment of various associative or descriptive terms which we have already described. In attempting to learn certain difficult features and in seeking to learn as many of the details of a material as possible, the observer frequently resorted to various *Aufgaben*. In some instances, the *Aufgaben* were present in vocal-motor-auditory images of the experimenter's instructions; frequently the experimenter himself was visualized, or he was

visualized as waiting in an expectant attitude for the exposure to end, or his watch was visualized, or he was actually perceived in peripheral vision. More often the *Aufgabe*, or the *Einstellung*, to learn as much of the material as possible, was present in terms of the observer's active, rapid, attentive manner of noting the material, and of his frequently repeated noting of certain details in order to imprint them securely. Sometimes the observer set up for himself *Aufgaben* similar to the experimenter's instructions; this act of instituting *Aufgaben* similar to the instructions of the experimenter may be conceived as an act of acceptance, or at least a more active use, of the experimenter's instructions.

It has been stated that the foreperiod, before presentation, was characterized by the adoption of a learning attitude, and that most frequently this attitude was a kinaesthetic adjustment to the apparatus and to the experimental surroundings. Strains and tensions, among other components, were largely indicative of this adjustment. Upon the presentation of a material, the strained attitude usually carried over to initiate the learning experience, but it contained elements of expectation, as we have seen; and as soon as the observer perceived just what the material was, there was usually a slight or total decrease of strains. This does not mean that the observer became more passive as regards his learning procedure; it means that his expectation was either satisfied or was terminated altogether. Bearing this in mind, we find that in many cases there was a gradual and progressive increase of strains and tensions in the course of the act of learning, frequently reaching a high degree of intensity up to the end of the exposure. And in practically every learning experience, the closing of the exposure of the presented material by the experimenter found the observer busy and intent in learning the details of the material.

The observer in the course of clearly perceiving and learning the material experienced certain associations, both verbal and concrete, of similar data and of objects and events suggested by the material. He made frequent remarks concerning the material before him. He perceived certain relations or lack of relations

between details, or between the details and the caption of a given material. In the latter case, he usually commented upon the inappropriateness of the caption or the like. Sometimes he misperceived the relations presented in the material or added new elements to it. All four of these phenomena, which are more or less similar in nature, we designate as *subjective interpolations*. In a later section of this paper (p. 108 ff.) we shall attempt to trace the influence of these phenomena upon the recalls, both immediate and delayed.

In order to substantiate the results which we have just discussed in regard to the observers' methods and procedures of perceiving and learning the materials presented, and to show the typical characteristics of the observers' introspections of their learning experiences, we here cite five quotations from our introspective data; these are chosen at random, and other quotations would have served our purposes just as well as these do.

LEARNING

Obs. F. Series I r. Presented Nov. 17, 1914. "During the foreperiod, my attention was concentrated, and I had vocal-motor images of the words, 'Gee! —I wonder what it (the learning material) will be?—probably those lettered-square things!' I was conscious of strains, referable to my concentrated attention, all over my entire body, and my breathing was inhibited. Then came the presentation by the experimenter. Immediately I experienced pleasantness, and closely thereupon there came to me the vocal-motor images, 'Oh! football!—he's punting.' My visual attention shifted to the verbal caption (located just below the picture) 'Kick-Off'; by visual perception I read the words of the caption, and just then came the exclamation in terms of vocal-motor images, 'the dickens he is!—that's rotten kick-off form!—it's a good punt—.' I experienced a great deal of motor imagery, kinaesthesia of movements of muscles all over my body, especially of all muscles necessary for the act of catching the ball and then of punting it. My pleasantness continued, and there were no accompanying or resulting organic processes of consciousness. Suddenly I became aware of the other football player; and I said in vocal-motor imagery, 'He's starting down the field on the kick-off, all right.' My attention dropped, and my pleasantness continued. Then came my remark, in vocal-motor imagery, 'it is an awfully long thirty seconds!' — 'Oh,—he wants one to master the details—'; then there was a keying up of my attention in a visual perceptual manner. The remainder of the learning period I spent in visually perceiving and in describing to myself by means of vocal-motor images the various details of the material, such details, for instance, as 'red ink,' etc. At the drop of the shutter, closing the presentation, I was prepared to introspect in verbal terms."

Obs. F. Series V 1. Presented January 5, 1915. "In the foreperiod, my visual attention was highly concentrated; I was experiencing strains throughout the upper part of my body, in my head, through my brows, and my neck, and my breathing was partially inhibited. I said, in terms of vocal-motor-auditory imagery, that 'I bet it is a mannikin!—wonder what it is like?' At that moment the experimenter drew the curtain and presented the learning material. With the presentation, these vocal-motor images came to me, 'yes,—mannikin—'; a consciousness of pleasantness had now come to me, and there was also a release of strains. I made the vocal-motor auditory remark that the mannikin was 'standing,' which latter experience was accompanied by a straightening of my own body, this straightening meaning for me that I was surprised which was also characterized by a sharp inhalation; there was here no experience of unpleasantness. The verbal description of the mannikin continued in terms of vocal-motor imagery, such details were mentioned as 'undraped—very natural'; at about that time my visual attention happened upon the label-caption which had not, up until now, been visually perceived,—vocal-motor 'oh! an orator!—yes, he is speaking,' which experience as a whole was followed by a motor image, without innervation, of myself assuming an attitude or posture approximating one which I would assume in making a speech but with my left arm extended with a general squaring of my shoulders and a throwing back of my head (all of these latter experiences were kinaesthetic images or perceptions of actual innervations, I cannot determine which). Then came the vocal-motor *Aufgabe*, 'get the details!—he emphasized the details,' with a nod of my head backward indicating the experimenter. There followed a visual perceptual examination of the mannikin with the accompaniment of a vocal-motor imaginal description of the details of the material in nearly the same terms in which I recalled them a minute or two ago in my immediate reproduction. In that visual noting, one fact stood out very prominently,—it was the detail of the hip-joints of the mannikin (the lack of beauty of the joints), and I experienced great unpleasantness and the vocal-motor commenting remark, 'rotten!' and there were also present strains of frowning. There followed another comment that, 'no;—have to (be jointed as they are) in order for them to be articulated;—if they were not, the mannikin could not do *this*' with a motor image of very strongly flexing my own hip-joint and of bringing my left knee up to my abdomen."

Obs. H. Series III 1. Presented November 21, 1915. "I was passive during the foreperiod, although, by means of these words, 'some English sentences,' present to my consciousness in the form of vocal-motor-auditory images, I anticipated and expected the presentation of verbal material; and, in addition to these vocal-motor-auditory images, I experienced also visual verbal images of sentences of verbal material. I then visualized the sentence which I was asked to learn at the last sitting, and this sentence was partly repeated in terms of vocal-motor-auditory imagery; and, although there were present kinaesthetic strains in my head, upper chest, and through my arms, and my breathing was almost inhibited, I felt very comfortable in taking the position of fixating the shutter which covered the learning material.

Then the experimenter presented the material—my attention, as manifested in my visual line of regard, was immediately attracted to the lettering of the words 'Rubes de Gink,' in order from left to right, and the word 'Gink' stood out most clearly, and I experienced a feeling of familiarity which consisted of a kinaesthesia of a slight relaxation all over my body and a passive, effortless, actual pronunciation of the words 'Rubes de Gink.' These words I repeated several times, and my visual fixation held on these words, as shown on the card material, for quite a while. Finally, in auditory-vocal-motor imagery, I said to myself this: 'Yes, he (the experimenter) meant this experiment to be a verbal one, dealing with the letters in these words (Rubes de Gink).' Then my attention, my visual regard, and the clearness of my visual perception shifted, as though attracted, to the cartoon of the man on the extreme left of the material, and held on the humorous expression on this man's face (Son-in-law of the 'Bringing-Up Father' cartoons). Unpleasantness began to come to me as I continued to watch his face, which all the while became much more clear and durable than the rest of the picture. Then I experienced the eye-kinaesthesia of my regard shifting to the second picture from the left of the four characters, and at that moment, I had also the kinaesthesia in my eyes of staring at the picture. The picture was that of the elder woman (Mother of the 'Bringing-Up Father' cartoons); I watched her face, and then there interposed itself in the experience the visual image of the man's picture (Son-in-law's) at which I had first looked; my fixation shifted to the latter's picture again, and then, by alternately shifting my gaze from one to the other, with consequent alternations in the clearness relations of my visual perceptions, I compared the two pictures; finally, my attention was fixed on Mother's picture—I noted her big hat—my visual perception then was accompanied by vocal-motor-auditory images of words in describing her. My visual perceptual regard and my eye-fixation shifted to the detail of her right ear where I visually perceived the diamond hanging;—in vocal-motor-auditory imagery, these words came to me, 'diamond is shining—.' My regard shifted to the third picture, that of the young woman (Daughter); I stared at her face, which was exceedingly clear, and this clearness of my visual perception persisted for a long time. My fixation and my perception shifted to the flowers she wore, and, in vocal-motor-auditory images, I said to myself, 'they are roses'; thereupon, my fixation shifted to her face, then to her head, and to her hair arranged in a dome-like fashion, and to her curls. Then, somewhat suddenly, my attention was attracted to the funny, humorous expression on the face of the character number four (Father), especially to his winking left eye, this latter feature standing out prominently in clearness—I was experiencing pleasantness—and the other details of the picture were very vague and obscure."

Obs. O. Series II 1. Presented February 26, 1915. "During the fore-period, I had an awful time trying to keep my attention from the material I learned at the last sitting; there were a great many visual images of white cards, localized up here on the screen; I kept singing in order to inhibit, if I could, these visual images. Just then the experimenter gave the instructions

that to-day he was going to present to me some new material to be learned. Then I said to myself, in vocal-motor images, 'I wonder if he (the experimenter) made a mistake—he presented me new material last time;—I'll wait and see.' I waited, attention being visually fixated on the screen all the while. The experimenter presented the card. Then I had vocal-motor images, 'no, it is a new material'; my visual line of regard went quickly and aimlessly over the details of the card. Then came the vocal-motor-auditory *Aufgabe*, 'go over it definitely and describe every one of the details'; and, so, I started to work under the influence of that *Aufgabe*, beginning at the top on the left side and working toward the right, and then down, visually noting and then describing in vocal-motor terms each square's contents, using such words as these, 'twenty-seven,' 'leaf,' 'g-o—ordinary writing,' 'blank,' 'green triangle and orange circle,' 'eight'; I did not name the material in the 7th square nor that in the last or 9th square. When I had gone through this procedure twice, there came the vocal-motor-auditory *Aufgabe*, 'get the blank squares'; thereupon I visually noted them and nodded my head at each one, having at the same time a kinaesthetic consciousness of this nodding. When the two blanks had been noted, I experienced an actual movement of my head down from one blank to the other. Then my attention fell on the 2d square, the one with colors in it; and then came the vocal-motor-auditory *Aufgabe*, 'now get the colors definitely,' and my visual line of regard passed all over the card;—vocal-motor-auditory 'all black but—,' and at this point there was a nodding of my head toward the 2d and 6th squares successively, and the colors in the 2d and 3d squares I described in terms of vocal-motor-auditory images, such as 'green triangle with orange circle,' 'eight, red'; 'no line either above or below.' There followed a more or less reflex going over the whole card again. While I was on the 1st square, I experienced the vocal-motor-auditory *Aufgabe*, 'I ought to try to recall it now;—no,—I wouldn't have time; go over them often in order to drill them in.' I got as far as the second line of squares, and then the experimenter closed the presentation by lowering the shutter. When I was on the 1st square of the third row of squares, I studied the details wholly through the kinaesthesia involved in tracing out the figure by head movements."

ii. *The Observers' Methods of Recalling the Material*

In their recalls the observers employed methods and procedures which bore a striking similarity to those which they had employed in perceiving and learning the materials. These similarities manifested themselves in great degree as regards the observer's learning and ideational type. In employing the term "ideational type" we shall not attempt to classify observers into rigid and distinct classes of imaginal representation; we shall mean only: *a*, that under given conditions with a given material, an observer was likely to employ certain modalities of images, and

to employ them in greater abundance than other modalities; and *b*, that the observer placed more reliance on the appearance of a certain sensory type of image in a certain situation than upon images from other sense modalities, and a certain image became for him an important contributing factor to subjective assurance besides being an expedient means of recall.

In a total of ninety-three recalls, of the eighteen different sorts of materials presented for learning in this experiment, Observer *F.* reported but two visual images; and these two proved to be fleeting, hazy, uncolored, non-intensive, and of brief duration. *F.* employed quite an array of vocal-motor-auditory verbal imagery, both associative and descriptive in nature. Of equal importance was his kinaesthetic imagery, probably of a more general character, of empathy, of localizing, of tracing and of drawing. He employed kinaesthetic modes of recall even to the extent of touching parts of his own body and clothing to represent details of a recalled material. Frequently he recalled and reproduced details in a reflex kinaesthetic manner, as in drawing on paper certain figures and diagrams. But it is to be borne in mind here that visual perception itself and eye kinaesthesia of actual innervation of the eyes played rôles of very great importance. The *process* characteristics of kinaesthetic and verbal conscious contents were carriers of meanings of great import for the observer. The manner in which contents appeared in and disappeared from consciousness,—the focal relations of contents and their changes,—the durability and the stability of the contents,—the temporal relations of contents,—the intensity relations of contents,—and the manifold different shades of inflection,—all these are aspects of mental contents which we mean under the term "*process* characteristics"; all of these factors were highly significant in the procedures of a logical sort of memory, which we shall discuss elsewhere (Section III B iv, p. 93 ff.). Every observer taking part in this experiment furnished introspective data in evidence of the fact that the process characteristics¹³ of his mental contents played worthy parts in his logical memory.

¹³ Wundt long ago realized the importance of the *process-aspects* of mental

Observer *B.* employed great amounts of visual imagery in every recall. The visual modality of representation was highly significant for her; her visual imagery varied from a great wealth of detail to images of the most schematic and fragmentary sort. Her introspections specify the presence of every degree of clearness of content, from complete focality and maximal clearness in the case of a dominating content to merely marginal presence and minimal clearness in the case of a peripheral content. Details were visualized in all forms, from a clear-cut and definite manner to a most indistinct, indefinite, and evanescent fashion. She frequently experienced the peculiar phenomenon of visual images superimposed one on another,—various degrees of fusion, and of discreteness, of visual images,—and various degrees of durability and instability. The manner of appearance of visual images, such as suddenness or flash or rapidity or slowness, besides the factors enumerated above, were of utmost importance. In addition to visual imagery, this observer employed practically all other kinds of imaginal representation,—vocal-motor-auditory verbal, empathic, manual-motor, etc. Sometimes the latter modalities were only subsidiary in function; oftentimes they played almost the principal rôle in the recall. In another section of this paper (III B iii, p. 78 ff.) we shall go more into detail in an attempt to determine the relation of forgetting, or the lapse of time, to the vicarious functioning of imagery. We may safely say that for *B.* visual imagery predominated over other modalities, that she employed other kinds of ideation to a less extent than did *F.*, and that in general she relied largely on her visual imagery.

The other observers varied in their employment of imagery between the extremes represented by Observers *F.* and *B.* If we arrange the other eight observers in order of predominance of visual imagery over verbal and kinaesthetic imagery we obtain contents, for he said (214, p. 123), “the ‘idea’ must be regarded as a process, no less variable and transitory than a feeling or a volition”; and (215, p. 389), “ideas themselves are not objects, as by confusion with their objects they are supposed to be, but they are *occurrences, Ereignisse, that grow and decay and during their brief passage are in constant change*” (the italics are ours).

the following sequence: *W.*, *Fs.*, *R.*, *H.*, *Fg.*, *O.*, *S.*, and *T.* Such a classification of observers as tending toward the visual or the verbal and kinaesthetic modalities does not mean that visual and verbal are mutually exclusive categories of ideation. We mean that, relatively speaking, some observers employed greater amounts of visual ideation than images of other modalities; that other observers employed relatively greater amounts of verbal and kinaesthetic imagery than visual ideation. As extremes and as representative examples of these two types, namely, those observers of a visual type and those of a non-visual type, we have mentioned Observers *B.* and *F.* Between these extremes the other observers are classified in the above sequence. Observer *T.*, like Observer *F.*, employed an abundance of vocal-motor-auditory imagery, and frequently reproduced by manual and ocular kinaesthesia of drawing, tracing, etc. He frequently reproduced details in what seemed to be apparently a reflex kinaesthetic manner; when the recall process had been initiated by some sort of image, the reproduction frequently continued to completion or near completion in an entirely automatic motor fashion, as in drawing on paper certain lines and certain other features of a material. Visual perception, and doubtless eye-kinaesthesia occurring with changes of fixation, and changes of focal or clearness relations in the perception itself, were in large part responsible for some of the apparently reflex reproductions. He reported visual imagery quite often, but in most cases these images amounted to little more than barest suggestions of the visual form. In fact, this observer experienced great difficulty in differentiating his visual images from visual sensations due to pressure on the eyeball (his eyes being closed). Observers *W.* and *S.* reported, in connection with visual images, the employment of great quantities of eye kinaesthesia. *W.*'s visual images were similar to *B.*'s in respect to their great wealth of detail; they also were similar to *B.*'s visual images as regards the manifold degrees of clearness which attended them; and they were capable of functioning in great varieties of situations and for the most various meanings. With *S.*, who perhaps occupied

a somewhat middle ground between *B.* and *F.* as regards the predominant use of visual over verbal and kinaesthetic imagery, visual images were always very frequent and were very significant for the observer. *Fs.* was largely visual, although she made frequent use of imitative movements of tongue and lips (of drawing and of tracing). She seldom reported eye kinaesthesia. The imagery employed by *R.* was very similar to that of *Fs.* Tending toward the visual end of the recall scale, that is having visual imagery preponderant over other modalities, *H.* and *Fg.* follow very closely after *W.*, *Fs.*, and *R.* Although at various times employing visual images in great abundance and with great wealth of detail, and despite the fact that visual images were highly significant in experiences of certainty and uncertainty, *O.* was forced to place strong dependence on the verbal and kinaesthetic components of his recall experiences, especially was this true when visual images failed to make their appearance or when they were extremely vague and schematic in character. In fact, the fusion or simultaneity of vocal-motor-auditory images with the present visual image was in most cases a contributing factor to the acceptance of a datum of recall as correct. In the above classification of observers according to their employment of now one kind of imagery and now another kind of imagery, we have made no hard and fast lines of division, nor have we attempted to maintain that any one modality necessarily excludes another modality; in fact, one can find no clear-cut lines of demarcation between the modalities employed by different observers. Every observer reported visual imagery, vocal-motor-auditory imagery, empathic complexes of kinaesthesia, and various forms of kinaesthetic reproduction which were concerned with drawing, tracing, and locating, etc.

That the recalls closely resembled the learning experiences of our observers as regards procedures and ideational types is well shown by the introspections of all observers. As representatives of the introspective material which we have on hand, and showing great similarities existing between learning and immediate recall, the following two introspections from Observer *H.* are typical and serve the purpose for which they are here inserted:

Obs. H. Series I 1. Presented January 13, 1916. "When the shutter was opened, my eye-fixation followed the movement of the shutter and some kinaesthesia of head movement was also involved. As soon as the material under the shutter appeared, my eyes fixated on the centre, and I experienced eye and head kinaesthesia more keenly; my attention was distributed at the centre of the stimulus-material. At first I perceived the material in a general, indefinite, indistinct, and unclear fashion. Soon my eye fixation was as though drawn to a spot on the upper portion of the card, and then the rest of the material disappeared from consciousness very quickly,—my visual field was narrowed at the white spot which developed slowly from its lower part to its upper part, in the succession of nose, eyes, and hair of the football player represented in the picture. Then appeared his ear and mouth. My eye followed down the figure, and I perceived the player's neck, shoulders, chest, and feet. Then I noted his hands; and then again my visual fixation went back to his face, which gradually developed as had the other features, perhaps more quickly and distinctly as far as details are concerned than the other features had done. This time I discovered the arm-band worn by the player, and distinguished between the white and grey shading of the player's body. When my visual attention was on the player's kicking foot in the air, I discovered the other player in the picture; this discovery was a fairly clear one. My eye-fixation alternated between these two players, and especially did I compare the styles of their football uniforms, and in vocal-motor imagery I concluded that they were football players. Then I became aware in visual perception of the title, 'Kick-Off.' I made some effort to remember the colors of the caption material, and at this time I felt strain through my body—visual fixation was held by the words of the caption. They stood out clearly and definitely and more durably than the other details of the material. My eye-fixation finally came back to the nearer of the two players, and in vocal-motor terms I said, 'two straight lines (wrinkles) in his trouser legs,' and my visual fixation followed these lines. When I noted his kicking foot, I had some kinaesthetic experience of kicking my own foot, and kinaesthetic images of my own arms assuming the posture presented in the picture. There came vocal-motor images of 'Yale and Harvard,' and a visual image of Harvard and then another one of New Haven, Conn. These visual images stood out more prominently in consciousness and more durably than the other processes of consciousness at that moment. Two or three times I tried to learn the material in kinaesthetic terms by trying to assume the position of the kicking player. And I tried in visual perception to localize the positions of the first and second players."

Obs. H. Series I 1. Immediate Recall, January 13, 1916. "I had a visual image of the whole figure, but the white places in the visual image were the most focal, and the details lying between the background and the men, the details of their shoulders and their feet, stood out distinctly. Then in the visual image I localized the player's head with the shadows of his hair and the outline of his head. Then a visual image of his ear which was not clear came to my consciousness. My eye-fixation, without a conscious-

ness of kinaesthesia, moved to the middle portions of his body, especially to the shadows and shades represented in his uniform. Then I rapidly visualized his foot as a whole and there was a very slight kinaesthetic image of my eyes moving and of my right foot starting to kick. A visual image of the other player then came to my consciousness, and there was no kinaesthesia of any kind,—this visual image persisted for a long time. When I visualized the nearer player's foot, there came to me a visual image of the word 'Kick-In' (mistaken for the word 'Kick-Off'). This player's posture was associated with the words, in vocal-motor imagery, that 'he is kicking in'; the player's posture was represented in a visual image. There was a vocal-motor-auditory description of every detail which followed the visual imagery of the details. I was uncertain as to the title of the material, and this uncertainty consisted of a fluctuation between the red and black of the letters of the caption—neither persisted—, and attention was impeded or held for a brief moment, and finally attention turned back to the persons of the picture."

iii. *The Effects of Forgetting and of the Lapse of Time on Mental Processes*

a. *Visual Imagery.* The visual image of the immediate recall was of the nature of a positive after-image, and usually made its appearance at first as a whole. It was focal, intense, durable, definite, clear-cut, and colored. It was localized at the place of presentation. The background or mounting of a material was fused into the one image, the principal figure or material being focal, with gradual and continuous gradations of clearness extending out from the focal figure. Changes of focality, from figure to background or to caption, or in an opposite direction, were easily and quickly effected, although there were no abrupt jerks or gaps in the clearness relations. The functioning of attention here was very similar to what it had been in the perceiving of the material when the material was learned. The shifts to the far outlying details, however, were not as precipitous as in the perceiving experience when the material was originally learned; in fact, the whole material was present in the one visual image to a greater extent than it was present in one clear perception. The image tended to become slightly typified in character; that is, certain features stood out prominently in clearness, while other features receded in clearness or did not appear at all in the image,—with the result that the content be-

came typified in the form that we described on p. 44 f.¹⁴. The feature which stood out was a feature which was very essential to the meaning¹⁵ of the material in question, such for example as the kicking-leg in the football picture entitled "Kick-Off" (Series I 1); or one side of the figure stood out in undue clearness and prominence, with no awareness of the other side of the figure, as if this side typified or represented the missing side,—or one arm represented both arms, or the front of a figure represented the back, etc. These introspections will serve to throw light on the phenomenon in question:

Obs. B. Series I 1. Immediate Recall, November 12, 1915. "The figure of the smaller football player in the background stood out, but not in a distinct or clear-cut manner,—it was not detailed."

Obs. B. Series V 1. Immediate Recall, December 8, 1915. "In the visual image of the brown statue, as my attention travelled downward, there was no awareness of either the right or the left side of the statue; there was just the brown streak in a downward direction showing only the front of the statue's body."

¹⁴ This process of typification is something other than the process of generalization; in a generalized content certain elements have of course been lost, while the remaining components are clarified and re-assimilated and re-combined into a new unity. In a typified content certain details have been lost and others have become less clear, while certain other details have been greatly magnified in clearness; this phenomenon of certain details receding in clearness and certain other details becoming more prominent in clearness, somewhat expressed diagrammatically by our figure of the cone (p. 44 f.), is the essential character of the process in question,—it is not a recombining or a re-assimilation but it is a progressive functioning of clearness by means of which certain details come to stand out representatively or to typify, certain other similar details; these details go in pairs. Instead of a re-combining process the phenomenon of typification is rather a process of growth or evolution of certain degrees of clearness which were originally present in the perception; this line of progress follows the trend present in the original degrees of clearness; if the detail, for instance an arm almost hidden from view, were only marginally or unclearly perceived, that detail recedes in clearness in the course of the recalls; while the detail, the other of the pair of similar details, the unhidden arm, grows clearer and seems to become more prominent even in perspective as if to represent the missing member. Very often the observer reports that he visualized only one side of a figure,—that he had no awareness of the two sides or that one side was lacking from his visual image. And this phenomenon reported by the observer we call the process of "typification."

¹⁵ See Meumann's discussion of this point (115, p. 137); see also our footnote on p. 75.

Obs. Fg. Series III 1. Delayed Recall, after 11 days, October 30, 1915. "I did not visualize all of the figures (the two men and the two women) of the group as clearly as I visualized the older man whom I call the 'old reprobate'; he seems to have become a representative character for the four persons of the picture 'Rubens de Gink' and particularly for the two men, that is, for the young dude and for himself."

Obs. Fg. Series V 1. Delayed Recall, after 70 days, February 15, 1916. "In the visual image I saw for a long time nothing but an extended right arm; by eye movements I strained in an effort to see what the shapeless but black something in the distance in my visual image really was; I repeated this attempt three times, my attention sweeping over the area of the visual image and always returning to this starting point of the extended right arm. Finally, the figure stood out as a whole, but not nearly so focal as the extended right arm, which even now continued to be very prominent in the whole visual image."

Obs. Fs. Series II 3. Delayed Recall, after 73 days, April 3, 1915. "Very suddenly there came a focal visual image of that colored circle, covering about nine inches (twenty-three centimetres) across the screen and localized there; it did not clear up gradually. The details standing out in it were the circle itself and the vague lines making the quadrants; none of the details were distinct except those of the upper right quadrant; two colors stood out, a saturated red and an ink green; the rest of the colors were dark or dull indefinite browns; the arrangements of the lines constituting the figure's form were by far the most prominent features."

Obs. H. Series V 2. Delayed Recall, after 93 days, May 20, 1916. "The shoulders, arms, and main part of the statue's body did not stand out clearly at all, although I had had vocal-motor-auditory images of asking 'how are those details?' but they continued to appear in a misty, far-off fashion; I could not visualize definitely their outlines,—they were fused with the background and looked brownish in color."

Obs. O. Series V 1. Delayed Recall, after 394 days, January 19, 1916. "The general visual image of the mannikin was vague, but the right side of the statue was much more distinct and clear than the left side; the right side was almost as clear as it had been in my perception of the mannikin; the rest of the details were present in a most marginal degree of clearness."

Obs. R. Series I 1. Delayed Recall, after 112 days, June 7, 1915. "To-day the figure stood out in my visual image in a sort of representative fashion,—that is, the features that I have mentioned seemed to possess such vague and shadowy connections with the other features that were clear. At the last sitting (53 days ago), if I remember correctly, the figure stood out as a whole; but today it seems to be broken up and then to be constructed of the isolated and disconnected or disjointed parts; a great degree of concentrated attention is necessary to bring any definiteness into the connecting parts of the figure."

Obs. R. Series V 1. Delayed Recall, after 7 days, May 6, 1915. "The

figure of the mannikin in my visual image seems to have become more stable, so that it does not oscillate as much as it formerly did; the visual images seem now to be more symbolic in character,—the gross important details of outline stand out; the minor or less important details do not come at all; the left shin, the left knee, the right hip, the right shoulder, and the left hand were not present in my visual image."

Obs. S. Series I 1. Delayed Recall, after 14 days, December 3, 1914. "I had a visual image of the football player as I started out to recall the material; this visual image showed a poverty of details. I began with the general position of the player's body,—this feature of the visual image was the first one to occur and was also the one most prominent in clearness."

Obs. S. Series II 3. Delayed Recall, after 14 days, March 18, 1915. "In my first general visual image of the material in this recall, the colors were not definitely anchored or localized; in fact, I was not aware of any particular color,—there was an awareness of the fact only that there were colors, for the colors all ran together or fused and appeared now here, now there, in random sequence."

Obs. T. Series V 2. Delayed Recall, after 7 days, December 23, 1915. "In the visual image as a whole the waist region of the mannikin and the general shape of his extended leg stood out prominently in clearness."

Obs. T. Series CI 5. Immediate Recall, January 17, 1916. "A visual image of the figure (the picture of a football player) was present from the beginning of the recall and persisted for a long time; this visual image gradually died out; it had presented the general position of the player and the greyness of the picture; and in this visual image there were arms to the player but there was no mark distinguishing the two arms from each other, and the visual image did not clear up as to these details."

Obs. W. Series I 1. Delayed Recall, after 30 minutes, November 14, 1914. "In my visual image of the football player the feature of the left leg raised in the air was much clearer than in the immediate recall; there was a rapid succession of features clearing up in the visual image, but this clearing up occurred only for certain outstanding details of the material."

This process of schematizing and typifying, however, did not reach extensive proportions in the immediate recall; it was one principal point of departure whence schematic visual images arose. This phenomenon was one potent factor in giving rise to the loss of details which images gradually underwent in the course of time. After the visual image had appeared as a whole, it was usually followed by an analytical procedure, in which dominant, important, and striking parts of the visual image stood out successively in clearness, and often with moderate intensity and long duration. These parts were arrived at by following

out the main figure until one dominant part was reached; but, even in the immediate recall, rather spontaneous, jerky and discursive appearances of these *foci* were at times to be noted. And this, we shall find, was one source from which issued the breaking up and the becoming discrete of visual images. The process of typification was responsible in part for the extreme clearness of certain details; the discursive, analytical, successive procedure of recall was also a factor which was conducive to an undue degree of clearness of certain details of a material. This exaggeration or increase of the degree of clearness, arising from the operation of these two factors of typification and discursive analysis, will be found to have borne an intimate relation in the later recalls with subjective distortions, interpolations, and constructions.

For those observers who were of the visual type, verbal and other kinaesthetic processes played a very minor rôle in the immediate recall; and when these latter did appear they were usually of a subsidiary or accessory nature; they usually did not precede the advent of the visual image but occurred synchronously with, and immediately following, the visual image or some shift of clearness in the visual image. For those observers who were not so dependent upon visual images, verbal and other kinaesthetic processes played a rôle of much less importance in the immediate recall than in recalls after delay. They served to initiate visual images, to fill out lacunae or indefinite points in the visual images, and to recall minute and difficult details. Very few processes which bore the character of logical procedures, such as inferences, judgments, certainty and uncertainty, acceptance and rejection, etc., occurred with the visual images of the immediate recall; after periods of delay, they came in. A discussion of such processes, and the effect of time upon them, will occupy our attention in another section of this paper (p. 93 ff.).

In recalls seven days after learning, visual images began to show indistinctness as regards their backgrounds and settings. The figures themselves were fairly distinct and clear, but less so than they were at the time of the immediate recall. The image

flashed into consciousness in a sudden and spontaneous fashion as a whole. It was localized in the place of presentation, sometimes not immediately; its color was somewhat less saturated and its intensity had decreased. In the latter two phenomena we see beginning a process which will eventuate, at least in part, in vagueness and haziness. The course and duration of the image was characterized by rapid shifts of focality from one feature to another, and this recall manifested a greater number of such shifts than did the immediate recall. The shifts were much more discrete and discursive in character than they had been in the immediate recall; the area moved over by attention or the shift of clearness was perhaps not as great as the area involved in the immediate recall. The latter fact was particularly true where attention or the shifting of clearness followed a continuous direction, such as following out the whole length of a line in one direction only, or beginning at the top of a figure and continuing to the bottom, etc. The typifying process was much more intensive and extensive in its effects. Details more remote from the focal detail or details, and details of least significance for the material to be recalled, made their appearance much more slowly in consciousness. Such remote and insignificant details were fewer in number than they had been in the immediate recall, many of them having dropped out in the interval of seven days; and those which were present were much more difficult to recall than they previously had been, oftentimes entailing eye-kinaesthesia of tension and strain, and sometimes kinaesthesia from other parts of the body, in the observer's effort to recall them. The more important details stood out clearly, but in a more indistinct manner than formerly. The appearing of the visual image as a whole was not of such a nature as to be so easily set over against the analytical and discursive procedure which had been characteristic of the second stage of the immediate recall. In fact, the two modes of appearing were nearer together in kind as well as in time, that is, a shorter time interval intervened between the appearing of one and the appearing of the other. In time, it was discovered, they had approximated a

mean, which manifested itself in the successive appearances of separate images, though schematic and hazy in character and quite similar in nature.

After fourteen days, the recall was more difficult to initiate. The observer's procedure in his endeavor to recall consisted in repeating the caption several times in vocal-motor-auditory imagery. Then there came a vague and non-localized visual image of the title. This was followed by a spontaneous, sudden flashing in of the visual image of the material as a whole, this image usually being localized just in front of the observer's eyes at a distance of thirty millimetres or so. One feature, the central or dominant one, or the most conspicuous one, of the material, stood out in relatively undue clearness, while the adjacent and less conspicuous features appeared in lesser clearness and in smaller size than the dominant focal feature; they were much more indistinct and undetailed, but of similar form with the focal feature. The focal feature was colored to a fair degree of intensity, while the more obscure features appeared hazy and washed-out; this fact, namely the haziness, and the washed-out character of the non-focal features, and the differences in size and clearness, gave to the image a tri-dimensional appearance, the adjacent non-focal details appearing behind the clearer, central feature; this phenomenon was very similar to the typified contents, which were discussed on pages 44 f. and 57 f. The visual image disappeared and reappeared several times, but the repetition of the caption in vocal-motor-auditory terms continued. The character of the image, together with its mode of functioning, and the continued presence of the caption-consciousness, indicated that a certain degree of forgetting had taken place and that a relatively slight degree of subjective assurance now attached to the observer's images. At a later stage of this recall, this image suddenly dropped out of consciousness. Slowly, in its stead, separate successive visual images of the separate details or features made their appearance. In this procedure of the coming of successive, discrete visual images, instead of one whole visual image, each separate image represented its feature much more clearly and in a more persistent and durable

manner than had been the case of the whole visual image of the earlier stages of this recall, although the far-outlying regions of each of these discrete images were blurred and indistinct. Empathy entered the experience as an aid to the observer in his attempts to recall the details and the general form of the postures represented by the material; frequent shifts in the visual images, with then similar shifts in the empathic imagery, occurred as processes by means of which the observer corrected errors in his recall and further augmented the quantity of the details already recalled.

In recalls twenty-one days after the presentation the visual image projected itself to almost any locality with relative ease. This phenomenon of the easy projection of visual images was characterized by the spontaneity with which the image changed its location; and the changes of localization were in no wise traceable to any deliberate or intentional act of the observer. The detaching of the location of the image from the place at which the material had been presented occurred in a rather progressive fashion in the course of time. The details were recalled by means of separate discrete images, which showed practically no fusion of, or flowing into, one another. The general shapes of certain features appeared in the visual image as a whole, but there were in this visual image rapid, jerky, and non-durable shifts of focality to the more specific shapes comprising the material. The shapes of features tended to shift and vacillate and to be very instable. In the first stages of this recall the shapes or forms of features were broken loose or were detached from their appropriate colors. The recall of the color was initiated by vocal-motor-auditory images; and this initial verbal recall was followed by a pale visual image of the color which appeared in a slow, non-spontaneous manner. When the color made its entrance into consciousness through a concrete visual image, it filled its proper space in the schema, that is, filled its appropriate and definitely localized form. And, after appearing in a definitely localized manner, the visual images of the colors alternated, one with the other, first as to position, and second as to their actual

hues or tints. A very significant feature of the functioning of the concrete visual images of colors in this recall was the fact that they were difficult to initiate and that they appeared in consciousness in a slow and tedious manner. In contrast to this phenomenon of a slow and labored arousal of visual concrete images of colors, the very existence of these images in consciousness was attended by all manners of fluctuation and vacillation, and they dropped out of consciousness in a very sudden and easy manner, and oftentimes the observer's efforts to hold them were in vain. These two phenomena,—the slow and difficult initiation of concrete visual images of colors, and the quick and spontaneous manner in which they disappeared from consciousness even against the observer's efforts to retain them, were two effects of forgetting and of the lapse of time. This recall was characterized by a profusion of eye kinaesthesia and motor images of the act of drawing certain features, and in numerous instances, by an inhibition of breathing. These kinaesthetic factors were very prominent in cases where the observer attempted to recall details of form and of color.

The recall after twenty-eight days was rather slow and hesitant; such contents as were here reproduced were initiated by a vocal-motor-auditory repetition of the title and by a visual image of the place where the material had been presented. The figure represented by the material, or the detail to be recalled, was present in this visual image but was localized to the right or to the left of the observer and appeared in a far-off distant manner; and it was of a shadowy texture. Here we see that the material, although it has been initiated in part by a visualizing of the place of presentation, has broken away from that location; further than this, the figure appeared bereft of its own proper background. And, increasing the complexity of the recall experience as well as showing the effects of forgetting, visual images of other figures or of other materials were superimposed upon this one. They were less shadowy in appearance and were characterized by a greater degree of focality. Even kinaesthesia of eye-movements entered the recall experience as if to aid the observer in his endeavor to see the figure more distinctly. To unravel such

a puzzling and highly complicated mass of images, to recall one as correct, the observer made use of various subsidiary processes;¹⁶—vocal-motor-auditory images, other visual images with varying content and changes of focality and durability, and empathic processes were of utmost importance in these acts of unravelling the recall contents. All visual images at this stage seemed to be blurred except perhaps for some extremely focal detail. The standing-out of a detail,—to whatever extent this event occurred,—the rapid and discursive appearances of other whole visual images, and the phenomenon of one or more visual images overlapping another visual image, manifested in this recall certain effects which they had wrought in the course of time on the recalled contents; subjective additions had been made in the details of the visual images, such for example as a football player “running down the field and looking back at a larger player.” (The picture which had been entitled ‘Kick-Off,’ had presented two stationary players, one behind the other; and no part of the football field had appeared in the picture). The following introspection is illustrative:

Obs. B. Series I 1. Two football players, the larger and front player kicking the ball; entitled ‘Kick-Off’). Delayed Recall, after 28 days. December 10, 1915. Two visual images had been overlapping a third one, with a veritable play of changes of focality and fluctuations of details. “In visualizing the arm positions of the front player I experienced some slight kinesthetic imagery in my own arms; the arms in the visual image were blurred and the blur held the focus of attention for a moment; then came another visual image of a football player, appearing as if on another picture in the background; the latter player was of small stature, in football regalia, and was running and looking toward the front or central player.”

The recalls after intervals of twenty eight days or more showed visual images which had suffered decay and obscurity in ways very similar to those which had characterized recalls after shorter intervals of time. In general, the images became progressively more vague and indistinct; they were less spontaneous in their advent; they were less intensive and of shorter duration; they showed an extreme degree of instability. Visual

¹⁶ We shall discuss all such subsidiary processes of consciousness in Section III B iv, p. 93 ff., of this paper.

images decreased in size, losing details rapidly at first and then more slowly as time elapsed. The details present focally in any one visual image manifested a certain well-knit, typified character; and they were characterized by only slight tendencies to analysis. The discursive shifts of attention between the details of any one image were very infrequent phenomena at this stage of forgetting. Although there were relatively few discursive shifts of attention which would have led to an analysis of any one image, yet there were a greater number of separate, discrete visual images; and these frequently overlapped one another, or they fused one with the other, or they alternated and fluctuated in consciousness. In recalls after long intervals, the visual images were found to be characterized by alterations, interpolations, omissions, and out-and-out newly constructed contents. The process of subjective interpolation, however, did not in general (so far as the recalls were carried in this experiment) continue to a point where the observer's recall contained nothing but alterations of old contents and constructions by means of wholly new contents. Visual images as wholes were characterized by frequent additions of details; a detail was added here, and another detail was added there, and there were alterations among the old details. The mass of recalled contents or the details in one whole visual image manifested the effects of additions and other sorts of alterations. There were no separate visual images, each image newly and wholly constructed in itself; the changes wrought by the passage of time and by forgetting, which we have denoted as subjective interpolations, always occurred within the body of details contained in one whole visual image. In other words, the constructive or additive process progressed more slowly than the destructive or subtractive process (forgetting proper) which was characterized by the dropping out of imaginal details. Or, to express it more adequately and more accurately, forgetting was the result of at least two somewhat reciprocal processes: a process of losing details, with a characteristic typifying and disintegrating of the image; and a process of subjective selecting, interpolating, and clarifying. The latter process, namely the

process of assimilation, moved more slowly than the process of dissociation and decay, and was in large part dependent on it. As time elapsed, however, we could see that the second process,—the process of subjective interpolating,—encroached upon the first process and henceforth progressed with greater acceleration.

To Freud belongs the credit for having discovered what are now called by some psychologists *conscious mechanisms*, by other psychologists *nervous mechanisms*. That there are mechanisms,—that is, organized, automatized and syncopated forms or modes of reactions to stimuli, whether in the fashion of conscious processes or patterns of reflex behavior,—cannot be doubted. That Freud's list of mechanisms exhausts the possibilities for the human behavior and for the human consciousness, can be seriously questioned. That his contention that these mechanisms are peculiar to a dream activity and appear only in dreams, is true, can be very seriously doubted; and furthermore, his assumption that the motive force and the origin of these mechanisms is to be found in some repressed sexual wish, dating back to childhood, is open to serious question.

He says (61; 79) that there are four principal mechanisms of dreams, namely: *Condensation*, *Displacement* or *Transposition*, *Dramatization*, and *Secondary Elaboration*. The mechanism of condensation, stripped of Freud's "unconscious" mythology, is that phenomenon of the reduction of a great multitude of details or data of experience to a few important items which occupy a small compass in consciousness, for example the details represented in the ordinary, everyday memory image. It would seem that had Freud been better acquainted with his own images of recall or of imagination, instead of with his dream images alone, he would not have devoted so much space or so much logic or so much myth to his dream-mechanisms; the ordinary image, namely the so-called memory-image, possesses many features in common with the dream image, the principal feature in common being this mechanism of condensation or representation, and very similar to it we have discovered a mechanism of *typification* which is characteristic of everyday forgetting and which on its face bears no evidence of repression or of a dream activity or the avoidance of a censor which separates the conscious from the unconscious.

Transposition or displacement is no more than the juxtaposing of details, for instance in a memory image, or the change from clearness to obscurity or the change from obscurity to clearness, or some detail which has been only minimally intense becomes in the course of repeated recalls (through ordinary images or through the images of dreams) maximally intense. This juxtaposing can take place in the spatial arrangement of details, in their temporal course and succession, in their focality relations, and in their intensity attributes. This form of alteration was the commonest to occur in memory contents in our experiment as the observers began to forget and continued to forget the materials that they had learned. So far as the phenomenon sheds light upon its origin it is no more than an ordinary process of forgetting; it is no more than the working of assimilation, and we have no

reason whatever to say that the phenomenon is peculiar to dreams or that it is motivated by repressed sexual complexes. It would be easier to say, and the saying would throw more light upon all the facts concerned, that the same process of assimilation which shows itself in the ordinary facts of forgetting also is responsible for the transposition and displacement of contents and details which one finds in dreams.

Freud supposes that the dream depicts always some situation or some action; this mechanism of action or situation is called dramatization. Another feature of this mechanism is its selecting influence on the contents that come to consciousness. With respect to the acting or the functioning which is always characteristic of contents of consciousness, whether they be present in the image of the dream or the image of ordinary memorial recall, we can say that there was dramatization shown in every recall by every one of our observers;—and this phenomenon has occupied our attention in numerous places in this article, where we have attempted to discuss fully the *process*-aspects of mental contents, particularly with regard to the mechanisms of acceptance and rejection, and certainty and uncertainty (pages 113 to 133). Our observers, particularly Observer B. (see page 98 ff.), frequently reported in describing their recalls of materials which had been almost entirely forgotten that the contents were very active,—the contents came to consciousness suddenly and disappeared from consciousness in a like manner,—the images seemed to be in play trying to supplant one another and at times seemed to attack each other, to ultimately fuse together,—and the observer seemed to sit back and to act only the part of spectator to this interminable dramatization of mental contents. It must be emphasized that the contents became more and more active the greater the progress of forgetting and the more extensively the details were loosened from their own backgrounds, from their associated details, and from their successive contextual accompaniments. Freud goes on to state that in the dream the dreamer does no intellectual work,—that there is intellectual work going on in the unconscious dream contents. We are not prepared to say that there was no intellectual work going on in our images of recall; in fact the evidence, that is mechanisms of acceptance and rejection, and mechanisms of certainty and uncertainty, points to the fact that there was a great deal of intellectual work present in every recall in our experiment; but this intellectual work did not manifest itself in consciousness outside of the contents that were present,—the contents themselves were working or were active and thus presented a situation or an event; and this functioning of recall contents was a selecting of contents, many of which were reproduced as true data of learning and many were rejected as not being correct, and many continued to function, to come to consciousness and to leave consciousness, in a manner which we may call rejection, and many of them incorrect and subjectively inserted were recalled and this act of reproducing them may be called acceptance. Besides the activity manifested in the contents themselves while present in consciousness, we may say that there was an activity present in the contents in moments between recalls; the recalls after various lapses of time indicated various changes in the contents, these changes having transpired after the previous recall was had; and, since the observer was not, in this interval of time,

conscious of such changes taking place in the contents, we must not say that the changes were occurring in some storehouse or dungeon of unconscious consciousness. It is enough to say that many happenings occur in the nervous system and we are never conscious of what happened; and frequently many things happen in the nervous system the effects of which happening we never have represented in consciousness until long after the happening has transpired. These facts do not necessarily lead one to posit the existence of a mysterious realm of the unconscious conscious with its mysterious ghosts and forces and guards and disguises, *et cetera*.

Secondary elaboration is a mechanism most familiar to those persons who have witnessed the passing of stories, and gossip, and scandal, by second and third hands; and to those persons who have been acquainted with the testimony given by witnesses in court; yea, it is a mechanism well known to those psychologists who believe that it itself is responsible for much of Freud's logic and system applied to dream events and to many details of dream contents, particularly for much of the logic and systematization to be found in Freud's interpretation of dream contents as symbols for hidden sex meanings. But we have found reason for asserting that the mechanism operates just as often in the images of everyday recall as in the dream and in the consciousness which just succeeds the dream; yet we are far from asserting that dream contents, on the one hand, and recalled memory contents, on the other hand (the two are not so widely different as this sentence would make them), are devoid of order, of sequence, of system, when they course through consciousness in their primitive or natural state; nor are we disposed to assert that their mere passage through or presence in consciousness, or the mere attempt by the reagent to unravel them, produces such a miraculous and such a neat and ordered change in them (the reader will find that we go more into detail in discussing this point in Section III B iv *b, c, d*, p. 108 ff.). Indeed, we have no evidence which would force us to go further than four laws of attention and Jost's law of associations go. These laws state that attention to a content increases its clearness and decreases the clearness of some content attended from; that attention to a content increases its intensity; that attention to a content causes it to rise into consciousness more quickly than any other content occurring simultaneously with it; that attention to a content lengthens its duration in consciousness; and that the recall of the older of two equally strong associations will strengthen the older much more than it will the younger. It is, however, our contention that, recall or no recall, there is present and there is active in the retained contents the working of both the mechanisms of dissociation and assimilation, and the effects of these mechanisms or the work that they have wrought will never be known to the reagent, or to any one else, unless the modified and altered memory contents are recalled at some time or other to consciousness or make their presence felt in some modified form of the behavior of the learner, who is also always forgetter; indeed, it is just the reagent, who has done the learning and the forgetting, who will be the last person on earth to fully realize that, during his sleeping and during his waking moments, while he consciously tried to recall what he had once learned or during moments when he was completely unaware of any attempt

to recall what the data of learning really were, that, all the while, he was elaborating the contents retained, and that, whenever later these contents appeared in consciousness, they bore the character of the effects of secondary elaboration. Freud's attempt to explain away what order or what system he finds in dream contents, by asserting that this order, and this arrangement, and this system is a symbol through which some hidden sex complex strives to see the light of day, is not only sheer logic, apparently done to cover up Freud's intellectual tracks, but is wholly gratuitous, and begs the very question which Freud is trying so hard to prove, and, what is more, his contention is a contravention of the facts of everyday forgetting which we have accumulated in this investigation.¹⁷

All of the four so-called "dream-mechanisms," namely, the mechanisms of condensation, displacement or transposition, dramatization and secondary elaboration,—alleged by Freud (79, p. 331) to belong peculiarly to a dream-making process which is "more distant from waking mental life than even the most determined detractor of dream activities would maintain,"—we have found to be present in ordinary, everyday acts of recalling learning materials after various degrees of forgetting have taken place. We have found reason for believing that they, the mechanisms, are mechanisms of *forgetting*;—they manifest themselves in the forms of forgetting which we have already discussed under the rubrics of dissociation or the subtractive process, and assimilation or the additive, alterative and interpolative process. We believe also that these two processes, of dissociation and assimilation, are responsible for much of the weirdness and the distortion found in dreams, and that, as a consequence of the workings of dissociation and assimilation, we can find the four mechanisms of condensation, transposition, dramatization, and secondary elaboration present in dream contents;—we believe that, at bottom, dream images and images of ordinary, everyday recalls, after much forgetting has occurred, are much alike and have much in common. We have found no reason for asserting that repression played even the most insignificant part in the forgetting of the various materials employed in our investigation;—the phenomena of forgetting furnish us not one single trace of the influence exerted by repression, nor do these phenomena bring to light any evidence of the existence of sexual complexes whose strange influences Freud would look for in all cases of dissociation and assimilation.

¹⁷ Parenthetically, we might add, there are other investigators who share with us our antagonism toward many of the monstrosities of Freudianism. Elsewhere, p. 4 f., in this paper, we have referred to the work of Ranschburg (156); we should like to call the reader's attention also to the discussions by the following men: Wells, F. L., (203, p. 126); Woodworth, R. S., Some Criticisms of the Freudian Psychology, *Jour. of Abnorm. Psychol.*, XII., 1917, 174-194; Stephen, A., On the Assumptions of Psycho-Analysts, *Jour. of Abnorm. Psychol.*, XIII., 1918, 17-22; Chase, H. W., Dr. Prince and the Question of the Subconscious, *Jour. of Abnorm. Psychol.*, XIII., 1918, 29-32; and Roback, A. A., The Freudian Doctrine of Lapses and Its Failings, *Amer. Jour. of Psychol.*, XXX., 1919, 274-290.

An observer actively resists forgetting. His seeming forgetting is more apparent than real. There are the processes of dissociation and assimilation, both active, destroying and modifying the contents. The former of these processes, the process of dissociation, moves faster in the initial stages of forgetting than does the latter, while in the later stages of the forgetting-struggle, the assimilative process moves with a greatly increased acceleration. Both of these processes produce and lead to very grave alterations in the recalled contents. And, yet, notwithstanding these facts, we must make the statement that the observer actively resists forgetting. We find him making use of a great number of procedures of a logical sort of memory in an effort to recall the material which the experimenter has requested him to recall. These acts, and these procedures,¹⁸ to offset forgetting and to aid memory and recall, included many processes of consciousness, many of them in themselves exhibiting only slight effects of forgetting and many others showing rather striking effects of forgetting. Indeed, even in cases where a long interval of time has elapsed between the learning-presentation and the recall, the observer sometimes reports that when he attempts to recall he finds that he possesses a great number and variety of visual images,—which alternate and fluctuate and fuse and vanish,—and yet, notwithstanding this profusion of imaginal content, he finally reports that he is unable to remember the experience which he has been asked to recall. In such an experience, however, the observer reports that he employed various aids and procedures in an effort to remember the originally presented material; these processes or procedures, such as attitudes of certainty and uncertainty, acceptance and rejection, inferences, etc., all constituting a logical sort of memory, played a most important part in the attempted recall, and, as criteria of the effects of forgetting, they were perhaps at this stage more important than the imaged or recalled contents themselves. They show resistance to forgetting and in many cases manifest in themselves certain effects of forgetting. These significant aiding processes will occupy our attention in a later section of this paper, where we shall attempt

¹⁸ Treated in detail in Section III B iv, p. 93 ff., this paper.

to throw light on the vicarious functions characterizing recalls after long periods of delay.

b. Vocal-motor-auditory Imagery. From our discussion of the observers' methods of recall and the analysis of the effects of time and forgetting on visual images, it is evident that as forgetting progressed the recalls of all observers tended to have recourse more and more to vocal-motor-auditory imagery. This does not mean that a vocal-motor-auditory image which had been present in the learning or in the immediate recall always continued to occur, or that its fidelity persisted unimpaired until the last delayed recall. It means that the relative number of vocal-motor-auditory images increased and that images of this modality became relatively more frequent as the time elapsing since the presentation became longer. Details which had been remembered in earlier recalls and which had not been present to consciousness in terms of auditory-vocal-motor imagery tended more and more to appear in terms of auditory-vocal-motor imagery as time elapsed and forgetting progressed. Then, too, the temporal order of the appearing of vocal-motor-auditory images tended to change; where, in the earlier recalls, the vocal-motor-auditory imagery had followed or had occurred simultaneously with other contents, in later recalls it preceded or escorted other contents. The fact that it was simultaneous with other contents, notably with visual and kinaesthetic imagery, or that it fused with them to form complexes in certain situations, was a matter of great importance to the observer. Its functioning or its advent at some particular point of a recall was a highly significant factor. As regards the life history of vocal-motor-auditory images from the immediate recall to long-delayed recalls two somewhat contrasting tendencies were to be noted. On the one hand, the images became more rapid and transient in passage, more synopated and fragmentary in content, and more loose and detached in their contextual relationships. On the other hand, the images took on significant modes of inflection,—such for example as forcefulness, emphasis, loudness, hesitancy, questioning, etc. Factors included under both of these classes played

worthy rôles in logical memory.¹⁹ Images of the first group,—that is, those which were more abrupt and transient, became progressively more mechanical and automatic in the course of time; in their coursing through consciousness their progress was more facile and unconstrained, and they received only a minimum of attention. The second above-mentioned tendency exhibited, on the contrary, a long drawing-out character of the imagery,—a haltiness, a slow flow of images. In the former class, connecting and relational words were slurred over or were hurried over, being non-intensive and manifesting only a low degree of focality; while the important words, and words having to do with significant details, were usually more focal, and sometimes were dwelt upon and emphasized. In the latter case, the two tendencies were not so far separated,—they were not wholly unrelated. Vocal-motor-auditory images, as time elapsed, tended to undergo certain repetitions by the observer in a given recall. The observer repeated certain details, sometimes in a questioning manner, and often in just a dead, slow level of intonation,—and when certain combinations or certain orders of the details were reached, the factors of rapidity, focality, ease, forcefulness, questioning,—the appearance of muscular, motor, organic and affective reactions linked with a given combination or order of the details,—and even modifications of the visual image itself,—and shifts of attention,—all these phenomena or any one of them may have exerted a determining influence upon the acceptance or upon the rejection of the material as correct, or upon subjective assurance or subjective lack of assurance, and may have determined just what the reproduction was going to be at this point. In this capacity, that is, as processes of a logical memory, to which we have so frequently referred in this paper, vocal-motor-auditory imagery was employed by all of our observers; such a state of affairs was frequent, and was especially so as forgetting progressed with the lapse of time. Vocal-motor-auditory images seemed well adapted to the recall and conservation of 1. more or less insignificant details of a material; 2. those details

¹⁹ In Section III B iv, p. 93 ff., of this paper, we shall go more into detail.

less essential to the meaning of the given material as a whole, and 3. those details artificially inserted by the experimenter. The more striking the detail, and in a measure the more extraneous or irrelevant it was to the dominant meaning conveyed by the picture or character represented by the material, the less was this one image in the course of time altered qualitatively by the dominant meaning to fit into the main context. In other words, we have a dominant meaning represented, for example by the picture of a football player kicking the ball with his right foot, and there are details, many of them of minor importance but all conducing to the whole picture as a whole, that is, to the dominant meaning; and there are other details which add nothing to the dominant meaning and subtract nothing when they are removed from the picture. The former details were the more likely in the course of time to be altered²⁰ in the direction of the dominant meaning; they underwent the effects of typification, generalization, assimilation, and of re-organization,—all tending toward a better organized apperceptive mass in the direction of that previously presented dominant meaning. The latter details, those irrelevant and extraneous to the dominant meaning, were the less likely to be altered qualitatively into the context of the dominant meaning; they tended to exist or to be conserved rather as independent, isolated, discrete images; and the more striking they were the greater were their chances for independent survival. This statement does not mean that nonsense material is better remembered than meaningful material; the details extraneous to the presented dominant meaning may possess great meaning taken in their independent entities. In fact, there seems to be a medial line, beyond which those details less linked up with meaning are more readily forgotten,—and above which details too closely in line with certain presented meanings are influenced and warped and altered in the course of time so that

²⁰ Meumann cites (115, p. 8) an illustration from Rodenwaldt which is apt here: observers who had been shown a picture of an infant in a cradle, remembered the cradle to be brown, whereas in the picture the cradle had been a conspicuous blue. On page 137 Meumann cites the fact that observers failed to remember the dog in one of Stern's pictures because the dog was not essential to the meaning of the picture as a whole.

they come to resemble and to represent certain details of a material which originally they did not very closely represent or resemble. The closer the relation of the detail to the general dominant meaning of the material, the more augmented was the effect of this kind of forgetting, namely assimilative or generalizing forgetting, upon it. The effects were not manifested so noticeably in an image of one detail itself, but in its context or in its associative connection with images of similar details. In a word, in proportion to the similarity of the details, other images in the course of time came to present details similar to those in the original material but which were actually not there; and by this phenomenon the general meaning was being added to and generalization in line with that meaning was in progress. This state of affairs is very much in accord with what we saw of the discursive, separate visual images, which underwent various forms of alternation, which overlapped one another, etc., allowing various subjective interpolations.²¹

In the course of time a given vocal-motor-auditory image suffered far less impairment than did a visual image. But, on the other hand, the vocal-motor-auditory image was more likely to be excluded or inhibited altogether, or to be wrought into erroneous combinations or associations during a recall; for instance, the verbal images of colors suffered transposition.²² And the likelihood of inhibition was probably greater in the earlier recalls, whereas later, at least with some observers, inhibition was less prevalent, the images having taken on a sort of mechanical functioning in a given sequence.

According to Ballard (21), verses, which have been memorized, are recalled more completely after an interval of two days than immediately after

²¹ Page 65 ff.

²² This fact is intimately related with Watt's conception of *Aufgabe* (199) and also with Ach's conception of *Aufgabe* and *determining tendencies* (5). The tapping of a certain line of associations necessarily opens up a certain trend of images which in turn excludes certain other possible reproductions; while, on the other hand, erroneous reproductions occur in a context due to the wrong mine being set off or the wrong string of associations being tapped or stimulated; resistance to the tapping of the wrong group of associations is slowly impaired in the course of time by forgetting.

learning. This phenomenon is called a "paradoxal reviviscence" by Huguenin (77), who attempts to measure it in a quantitative fashion. Seventeen girls, whose ages ranged from eight to eleven and one-half years, served as observers for Huguenin. Fifty-one lines of "*la Fin du Monde*," by Aicard, were memorized and reproduced in writing immediately afterwards; other recalls of the same poem came after intervals of one, two, six, and eight weeks. Huguenin's results, as follows,—

RECALL	AM'T RETAINED	NO. OF ERRORS
Immediate	5.4	2.2
After 1 wk.	5.8	4.2
After 2 wks.	6.2	3.7
After 6 wks.	5.9	3.2
After 8 wks.	6.0	3.3

show that the greatest recall comes after a period of two weeks, but the amount of "reviviscence" is greater the younger the observer. Ballard has found that the recall of new parts of a poem (*i. e.*, parts not recalled before) runs parallel with the forgetting of parts which had at one time been recalled by the reagent; but Huguenin failed to confirm this finding. However, Huguenin did discover that the line of poetry which is newly revived after an interval of time is invariably a line which follows immediately after a line which had been recalled previously. Simultaneously with this process of "reviviscence" there is an increase in forgetting. Huguenin, like Cionci (38), believes that this phenomenon of "reviviscence" is due to distractions which were operative while the poetry was being memorized. Cionci, in his own investigation (38), found that there was an increase of forgetting with time, if the learning had been attentively done; but forgetting decreased with time, to a minimum from which it subsequently rose, if attention had been distracted while the material was being learned.

We have found very little evidence in our investigation to confirm either Ballard or Huguenin; at the outset, we attempted a qualitative rather than a quantitative study, and the lack of quantitative data would, of itself, prevent us from confirming these investigators whose studies were by quantitative methods. But, notwithstanding our lack of quantitative data, we have found only slight evidence of any kind whatsoever to establish that our observers recalled, after various intervals of delay, contents, items, and details of their learning materials which they had neglected to correctly recall immediately after learning; this statement does not touch those details which are subjectively and incorrectly inserted in the later recalls, but refers only to those correct contents which are supposed to have been absent in the immediate recall and to have been present after two days, in Ballard's experiment, and two weeks, in Huguenin's experiment. We are strongly inclined to agree with both Huguenin and Cionci that the distraction of attention during the act of learning would cause such phenomena as they have described, and, in fact, Ranschburg (156) has already pointed out that many forms of temporary and capricious forgetting are so caused. But every learning in our experiment was done with the most highly concentrated attention, and each learning continued for a period of only thirty seconds;

these facts would account for our relative lack of the phenomena of reviscence.

Later recalls showed a greater frequency of the total dropping out of whole vocal-motor-auditory images. This had its rise, in part at least, in the fact that in the early recalls certain details had been slurred over and certain other details had been emphasized, while at the same time there had been a contrast of focal relations between the details, some having been unduly clear or persistent or emphasized and others having been only minimally clear and perhaps instable and short in duration. Another factor contributing to the phenomenon of the total dropping out of vocal-motor-auditory images in the course of time was the tendency to inhibit one another which some details had undergone in the earlier recalls. This factor also played an effective rôle in the observer's logical procedures after forgetting had made some progress, and in his lack of subjective assurance. The phenomenon was very similar to that manifested in visual images, which, we saw, tended to dissolve, to become discursive and discrete in the course of time. But the fact that vocal-motor-auditory images are not simultaneous constellations but successive trains offered a greater opportunity for the dropping out of a whole image, while the fact that in the visual image several elements are organized into a single image provided a condition which was favorable to discursiveness.

As forgetting progressed certain subsidiary and vicarious modes of representation made their appearance in the course of time and aided the vocal-motor-auditory images as means to recall. We have already mentioned such factors as hesitancy, emphasis, change of inflection, etc. In other factors, which we now discuss, the observers showed exceedingly great individual differences. As forgetting progressed, Observer *F*'s auditory-vocal-motor imagery tended more and more to be initiated by kinaesthetic factors,—by kinaesthesia of locating the material at the region where it had originally been presented, of localizing the position within the group which had been occupied by certain features, or of estimating the total amount or size of the original material. These kinaesthetic factors usually included

manual-motor images or actual innervations of pointing to the place of localization, of moving the hand and then pointing to represent size and location; oculo-motor images and actual innervations of movement and of location; and kinaesthesia of the head, neck and body, having to do with nodding, pointing, leaning, and the like. Observer *T.* also tended to initiate his longer-delayed recalls by the use of kinaesthetic processes. He was more addicted to the employment of eye kinaesthesia; but he had recourse also to manual and general bodily kinaesthesia, of locating, pointing, drawing, and the like. In his later recalls, however, this observer's cues of localization and of estimating and remembering size also tended to be present in terms of visual imagery. These visual images were very schematic, vague, and evanescent; indeed, they were so schematic and fleeting that they furnished no information other than hazy indications as to size and localization. In the earlier recalls, Observers *S.* and *W.* had employed relatively small amounts of eye kinaesthesia with their visual images; and at this earlier stage, *W.* had possessed a great wealth of visual content and very little verbal, while *S.* had employed great quantities of verbal imagery in addition to an average amount of visual content. But, as forgetting progressed, both of these observers tended to employ in the course of time greater and greater amounts of eye kinaesthesia as aids to recall. In addition to the increased amount of eye kinaesthesia, as forgetting increased, Observer *S.* exhibited in the course of time also ever increasing amounts of manual-motor, head-motor, and general bodily kinaesthetic contents. In contrast to this profuse and ever increasing wealth of kinaesthetic content in the case of *S.*, the kinaesthetic means of recall was in the case of *W.* limited almost solely to eye kinaesthesia; but throughout the later recalls *W.* continued to employ large amounts of visual imagery for locating the position of certain details in the whole mass of details of a material and for estimating the approximate sizes of certain materials or certain details of a material. Observer *B.* was in the course of forgetting always prone to employ visual imagery in locating details and in estimating sizes of features. Notwithstanding this fact, however, she tended more and more in the

later recalls to experience eye kinaesthesia and general bodily kinaesthesia of fixating the place where the original presentation had been made, locating the position of certain details, and in initiating and re-enforcing her vocal-motor-auditory recalls. The later recalls of Observer *O.* were more and more, as time went on, characterized by the frequent kinaesthesia of nodding his head to denote a certain localization or a certain direction or shape of the features of a material. In addition to this form of kinaesthetic recall, Observer *O.* employed very frequently in the later reproductions kinaesthesia of eye-movements, of leaning his body in one direction or another to represent some form of the material, and of pointing his hand to localize certain positions or directions of the details, and the like. He also employed the visual manner of locating, imaging the place where the original presentation had been made, and infrequently visualizing the locations of the details (here eye kinaesthesia and kinaesthesia of head-movements became very frequent as forgetting progressed). His visual mode of localization tended to become more and more schematic and vague as time elapsed, and the kinaesthetic components of the recall increased in their frequency with the progress of forgetting. In an effort to initiate the recall, Observers *Fs.*, *Fg.*, *R.*, and *H.* tended always to visualize the locations of the materials, and in the course of forgetting, the recalls acquired to a large extent the modality of the vocal-motor-auditory image; and, thus, the visual image of the location of the material was the cue which initiated the verbal recall. But, as time elapsed, everyone of these observers employed greater amounts of kinaesthesia in locating features of a material and in estimating the approximate sizes of the details. They were, however, less prone to employ kinaesthesia in recalling than were other observers.

This leads us then to a discussion of the effects of time and of forgetting on the kinaesthetic components of the earlier recalls and occurring at various places in the later recalls.

c. Kinaesthetic Factors. Empathic experiences increased in the frequency of their occurrence with every observer in the

course of the delayed recalls. This increase was very noticeable in the case of Observer *F*. Where the observers in earlier recalls had visualized the postures represented by the material, they tended more and more to represent those postures in kinaesthesia of their own bodies as time went on. This does not mean that empathic representations did not suffer qualitative changes in the course of forgetting and in the course of repeated delayed recalls. In fact, except for Observer *F*., this mode of recall suffered as much as, if not more than, the visual image. In the course of time, empathic recalls tended to occur much more spontaneously than was the case in the earlier recalls; fewer initiatory or antecedent processes, such as visual images and vocal-motor-auditory characterizations, were needed to set off the empathic recall. We may note at this point that Observer *F*., after visually perceiving a presented posture of the mannikin immediately in recalling made use of the empathic or kinaesthetic modes of representation. This phenomenon is exactly the reverse of the well-known and commonplace fact that individuals, noting an object or a drawing in a kinaesthetic and tactual manner with eyes closed or blindfolded, usually tend to visualize the material rather than to represent or recall it in kinaesthetic and tactual images. The employment of tactual and kinaesthetic imagery in recalling the object in Series B 1, which had been presented in a kinaesthetic and tactual manner, is well illustrated in the case of Observer *F*. Whereas, the employment of visual imagery to represent the same object is illustrated by Observer *O*. In the course of noting, Observer *O*. visualized the object, with now and then a kinaesthetic and tactual image very intimately fused with the visual; Observer *F*., on the other hand, noted the object in a purely kinaesthetic and tactual perceptual manner, and in the immediate recall and in recalls after various intervals of delay reproduced the object by means of kinaesthetic and tactual imagery. Observer *O*. always tended to visualize the object, although, as his visual imagery became more schematic and vague and more marked by discursive shifts of attention, the relative number of kinaesthetic and tactual images, as opposed to visual images, increased as forgetting progressed.

As indicated above, empathic imagery became more spontaneous as time elapsed. It became more spontaneous in two respects. In the first place, it tended to initiate itself, so to speak, in greater frequency without initiatory cues, such as visual images of the presented posture or some characterization in vocal-motor-auditory terms. This manner of appearing, however, was not characterized by excessive clearness of a focal sort or a very great degree of intensity; in other words, the appearing was not jerky or precipitous. In the second place, the empathic representation tended in time to take on a spontaneous character which manifested itself in two forms not altogether unrelated. The first of these may be termed a unified, facile, unconstrained form of empathic image; it was characterized by a somewhat diffused attention; and it appeared somewhat as a whole, and was free from sharp, discursive shifts of focality. The second aspect, closely related to the first in its ephemeral character, was a sort of continuous, constant instability or vacillation; this tendency to shift was quick and easy in appearing but was not characterized by jerky or precipitous breaks; in fact, just the character of unbrokenness, characterizing its vacillation, and the ease and quickness attending the shifting, are the principal aspects of its spontaneity and of its ephemerality. In the early recalls, particularly in the immediate recall, a high degree of fusion, or of simultaneity, characterized the appearance of the empathic attitude with the focal visual image of the presented posture. The observer was intently visualizing, for instance, an arm of the mannikin extended in gesture, while at the same time he experienced empathic images of being himself in the same posture. As forgetting set in, the visual images (or verbal characterizations) tended more to precede the empathic attitude in a successive fashion. In this case, the empathic experience was very focal; it was perhaps more focal than the visual image or verbal process which had preceded it. But in the longer delayed recalls, as already stated, the empathic attitude tended to occur spontaneously without the intercession of cues; and then simultaneously with, and following the empathic attitude, the observer

tended to visualize his own body, or parts of his own body, in the posture represented. This process of visualizing was closely connected with increased focality of local kinaesthesia incident to actual innervation of some parts of the body. This state of affairs resembled to some extent the process by means of which visual images were dissolved and became discrete. But it also showed that the kinaesthetic complex, although undergoing disintegration to a certain extent, tended to become more reflex in its constituent parts,—for instance, the detail of bending an arm was represented more mechanically, the arm being actually bent by the observer; and the kinaesthetic and tactual sensations therefrom were very focal in consciousness. On the other hand, a constituent part of the original total empathic attitude, in time, decreased in the extent of the area, or of the number and the definite localization of the muscles, involved. This was at least one aspect of the increase in unitariness and of the gradual acquisition of an ephemerality characterizing the empathic attitude in the course of time. After very long periods of delay the kinaesthetic attitudes of empathy had attained a very schematic and evanescent character. Now they occurred successively and in discrete fashion; they were little characterized by continuity,—sharp, jerky shifts of focality separated them; and frequent shifts, alternations, and fluctuations occurred in them, bringing to the observer uncertainty, hesitation, etc.;—in the course of forgetting even the empathic mode of recall is found to have broken down in its efficacy.

The recalls after long periods of delay included such kinaesthetic components as eye-movements and general bodily kinaesthesia of leaning, pointing, nodding, and the like. These kinaesthetic components became more and more prominent, absolutely and relatively, and of greater importance, as forgetting increased. Locality, direction, shape, and size were very largely represented by means of kinaesthesia by all observers; by visualizers, in cases where their visual images had suffered in extent, in intensity, in clearness, in distinctness, and in unitariness; by the less visual observers, at all times, but particularly when the verbal represen-

tations broke down or failed to represent the above-mentioned details. Usually some kinaesthetic process, actually innervated in company with visual perception itself, or imaged (alone or with a visual image), initiated a recall. We have already characterized the "learning attitude" which had attended the noting or learning experience; and we have seen that there was a typical "recall attitude." The former usually attended a recall, and was the most important means of initiating that recall, of obtaining the correct material from the whole group of materials employed, and of locating the whole datum or certain details of it. And, when this attitude did not occur, the "recall attitude" made its appearance. If neither occurred, a recall was most often impossible to initiate,—the observer failed to get started.

Pillsbury's statement (153, p. 144 f.) that "what is recalled at any moment depends upon the idea that was in mind just before, and upon the mental attitude of that time—the general setting that gives the particular association its direction" is substantially correct. Many people recognize the fact that oftentimes it is necessary for them to "get back into the learning situation"—that it is necessary for them to recall the circumstances which attended the original learning experience if they are to remember correctly a given datum of experience. The effect of the "learning attitude" upon acts of remembering was recognized by Aristotle who put the matter in this fashion (16, p. 206): "When a person wants to recall a thing, he will do the following: he will try to gain a starting-point in the process, in sequence to which the desired experience was had. Consequently, recollections which are awakened from the starting-point are most quickly and best effected." Aristotle was also familiar with the functioning of the "recall attitude," for he says (16, p. 206) that "oftentimes one is unable to recollect a thing, but after *searching* succeeds in finding it. This seeking and finding is what happens when one awakens a number of experiences and continues to do so until one sets that particular experience in motion upon which the desired thing is attendant." In more recent times, namely 1913 and 1914, Müller-Freienfels (125, 126, 127, and 128) and Gallinger (64) have emphasized the importance of such attitudes, as above described, in acts of remembering.

Pillsbury says that what attitude one shall take and what turn there shall be in the course of one's associations are dependent upon the function of attention. In a like manner, Sybel states (177, p. 287 ff.) that in forgetting it sometimes happens that the visual image is subject to variation in its magnitude, presumably in consequence of the distribution of attention. Of both Pillsbury and Sybel we are constrained to ask, what determines what shall be the functioning and the distribution of attention in successive recalls of the same material after various lapses of time? This question will find, we hope, a thorough answer in this paper; we believe that we have discovered that the

degree and the quality of forgetting are at least in part responsible for the different modes of functioning and the distribution of attention during acts of recall. This fact we try to drive home throughout the course of this paper but particularly in Section III B iv *c* and *d*, page 113 ff. Stout's statement (173, I., p. 194, and II., pp. 3 and 140), although making attention exhibit a traditional dynamic valence, and failing to show from what source attention obtains the controlling force which it is supposed to exercise, can be made to correlate with the view that we here present; his statement is substantially as follows: the process of attention shows an inhibitive aspect in that it is a unified process that excludes everything which does not belong to the particular system of ideas which holds the attention at any one time. Each mode of the mental process tends to arrest and suppress all others, and is successful in proportion to its intensity and systematic complexity. There is a very compact resistance offered by a highly complex group of processes in systematic union and effective co-operation. This statement leads us to ask, on what do "intensity," "systematic complexity," and "effective co-operation" of associations depend? Our data would force us to this answer,—in part upon the degree and the kind of forgetting which has taken place. If we succeed in showing that forgetting is a cumulative function which hinders or facilitates progressively more forgetting in circular fashion, we shall have added to a long list by Meumann (115) another factor which contributes to the establishment, the operation, and the decay of associations.

The "learning attitude," which we mentioned on page 84, consisted, in its kinaesthetic components, of modes of fixation and of localization,—for instance, to the curtain (in Series V with the mannikin) or in that direction,—to the shutter (in Series I, CI, II, and III),—to the top of the table (in Series IV), and to the experimenter's table (in Series BI). On the other hand, the "recall attitude" consisted to a great extent in kinaesthesia of frowning, closing and straining the eyes, eye-fixations here and there in trial recalls, general bodily strains and tensions, etc.,—all characteristic of effort and of activity. The frequency, the priority, and the importance of these attitudes in the observer's getting started on the right track to recall, showed very well the significant rôle of kinaesthesia in recalls and in an observer's resistance²³ to forgetting.

²³ We venture to suggest that if Abramowski's (2, 3, and 4) "generic feeling" had been submitted to closer introspective analyses, complexes containing in large part kinaesthetic factors would have been found, and even other factors not at all in the nature of pleasantness or unpleasantness, as modes of resistance to forgetting. In fact, Betz (26, I.), who once smiled at seeing a man drop a lighted cigar on the floor of a crowded street-car, was, after the lapse of several days, enabled to recognize this same man because, upon

Besides the forms of kinaesthesia so far discussed, another general class, somewhat similar in nature to the "recall attitude," functioned more especially in regard to acceptance and rejection of a datum as correct or as incorrect. This sort of kinaesthesia was in the nature of general or particular bodily tensions and strains, on the one hand; and of relaxations from, or decrease in, the tensions and strains, or their total absence (*i. e.* a *passive* or *composure attitude*), on the other hand. This phenomenon entered as one of the factors attending the processes of logical memory, and we shall have more to say of it in another section of this paper. It was a highly significant process, and increased in the frequency of its occurrence as forgetting progressed. Chiefly points of difficulty, and points where a difficulty was solved or could not be solved in the recalling of a whole material or certain details of a material, were characterized by the process in question. Needless to say, as forgetting went on and fewer data of memory were recalled and the associations became progressively weaker, the process functioned at incorrect points, or functioned incorrectly, thus permitting subjective alterations and constructions; this phenomenon is quite in line with what we have seen of forgetting thus far,— there is resistance, by means of various logical procedures, to forgetting, but in time they too become less and less valuable and increase in their inaccuracy.

In general, as to the kinaesthetic modes of recall, we may say that, except for the empathic attitudes and perhaps eye kinaesthesia of localization, the kinaesthesia only roughly and generally represented the original material and its details; such recalls were schematic and not very accurate at best, and not very minute in extent. Fine and minute points of localization, direction, size, shape, etc., were only roughly indicated through kinaesthesia. The finer points of detail, such as those just mentioned, were more accurately carried by visual imagery (if the observer

seeing the man again, Betz reflexly began to smile before he realized who the man was; Betz immediately introspectively described his recognition-consciousness and found it to be composed largely of the kinaesthesia of smiling.

was prone to employ visual imagery) and by vocal-motor-auditory descriptive processes. But the curious phenomenon is that the kinaesthetic modes of recall suffered least in the course of forgetting, and were, on the whole, the last processes to be affected even to a slightly deleterious extent.²⁴ The kinaesthetic processes followed the same tendencies of deterioration as the empathic attitude in the course of time. The effects of forgetting, however, were less noticeable. The empathic experience was characterized by a sort of fused or organized or unitary complex of kinaesthetic elements; and, in view of its well-knit, organized character, it resembled the visual image. And, naturally, an organization or a complex of many elements, not discrete in character, was most likely to disintegrate and to permit of fluctuations and alterations and dropping-outs in great variety. But the effects of forgetting upon the simpler kinaesthetic components, such for instance as the kinaesthetic factors of localization, direction, shape, size, and the like, were much smaller than the effects of forgetting upon the larger complexes of kinaesthesia. These simpler kinaesthetic components in the course of time lost details as wholes, which dropped out of the retained content, much in the same manner in which a train of vocal-motor-auditory images loses certain of its members; but the frequency of this phenomenon was least with the kinaesthetic factors of a recall. A much more pronounced effect of forgetting was exhibited in the tendency of the simpler kinaesthetic images to alternate and to fluctuate, on the one hand, and to become more general and roughly indicative of the position and forms represented, on the other hand. The latter phenomenon, namely the general obscuration of the simpler kinaesthetic contents, was much less frequent and much less intense than the

²⁴ Finzi (56) reports that visual imagery is less subject to falsification of content, but shows more errors of position. Our results exactly reverse the former statement, if increased periods of delay are taken into account. In the earlier recalls (immediate and recalls after short delays), the visual image furnished the most accurate and minute details of position, form, and localization; but in the course of time and with forgetting, the kinaesthetic manner of locating perhaps surpassed the visual in the correctness of position.

phenomenon of the alternation and fluctuation of the simpler kinaesthetic components of a recall.

The tendency to oscillate was closely related to the increased slowness and hesitancy characterizing this particular class of kinaesthetic processes after longer periods of delay. The tendency to become slightly less accurate and definite may have been intimately connected with a slight decrease of intensity and with that sort of schematic ephemerality which we attempted to describe in discussing the empathic experiences. In the earlier recalls, the observer (except in the case of Observer *F.* and perhaps Observer *T.*) attended very little to such kinaesthetic factors as aids; but, in the later recalls, he paid close attention to such aiding processes, which now were not so clear as they had been originally.

d. Affection. As already stated, the original noting of the material was, in most cases, not attended by pleasantness or unpleasantness. In some cases, the difficulty of understanding or perceiving the material was accompanied by unpleasantness and the ease and quickness of perceiving and understanding the material were attended by pleasantness. Emotional complexes were sometimes present, though infrequently; they consisted of attitudes of surprise, amusement, excitement, wonder, awe, dismay, delight, disappointment and disgust. Of this whole list, only the attitudes of amusement and of disgust recurred in some of the earlier recalls, and this recurrence was very infrequent, the recalls after one or two weeks showing no traces of them. The experiences of pleasantness or unpleasantness, present during the presentation of the material, tended to disappear at once; the immediate and the delayed recalls showed no traces of the original occurrence of affection. In fact, there was no discoverable correlation between presence of affection in learning and accuracy and correctness of recalling.²⁵ And, in the delayed recalls, the

²⁵ This fact fails to confirm Tait (179), who holds that learning materials attended with pleasantness are better remembered than those attended with unpleasantness, and that both are better remembered than indifferent impressions. Moreover, we have no guarantee that Tait's observers really experienced the feelings which the word-stimuli were expected to arouse. Our

increasing frequency of unpleasantness especially and to a certain extent the relative increase of pleasantness, were great. Affection seemed to occur only at points of success or failure to recall.²⁶ The appearing of any datum, whether correct or incorrect, just at the moment when the observer's efforts to recall were most active, contributed to the feeling of pleasantness; this occurred very frequently and most frequently after forgetting had made an extensive headway. The failure of the observer to "get started" upon a recall, or his failure to remember any datum in a recall, usually contributed to the feeling of unpleasantness, and this experience of unpleasantness was the more intensive the greater the observer's efforts in attempting to recall. Affection, in this light, appeared only as an indicative or incidental factor in the success or failure of the observer to recall something; indeed, the affection seemed to follow in a great many instances after the observer's attempts to recall, or, at least, to conclude the attempts to recall; the affective experience never preceded the efforts of the observer to recall and only at rare intervals did it appear simultaneously with the efforts to recall. Pleasantness does not, therefore, appear to play the rôle of "stamping-in" impressions, nor does unpleasantness appear to function to "stamp-out" impressions.

Thorndike (181 and 183) advocates a view that "satisfyingness," presumably meaning pleasantness, functions to stamp in neural connections when a successful act is consummated by the reagent;—and that "unsatisfyingness," presumably meaning unpleasantness, functions to stamp out, or to obliterate, neural connections when the reagent's acts lead to failure. Data presented by Watson (198), and data accumulated in our own investigation, would tend to support a view almost the inverse of that of Thorndike,—a view namely that "stamping-in" produces, or contributes to, pleasantness, and that "stamping-out," or obliteration, produces, or contributes to, unpleasant-

findings are more in agreement with those of Gordon (68), who required her observers to introspectively report the occurrence of feelings when they were learning and recalling colors and forms. And Gordon has shown that the results obtained by Colegrove (42) and Kowalewski (86), namely that pleasant experiences are better remembered than unpleasant events, is altogether a different matter from asserting that pleasantness contributes to "stamping-in" or to the strengthening of retention, and that unpleasantness exercises a "stamping-out" or an obliterating function.

²⁶ See Clark's discussion of a similar point (41, p. 481).

ness. Moreover, "stamping-in" is not always accompanied by pleasantness, nor is "stamping-out" always attended by unpleasantness, if success be a criterion of "stamping-in" and failure a criterion of "stamping-out." This latter fact would seem to lend weight to the view that the affective process is incidental in character. One rather wonders why Thorndike, of all psychologists, should ascribe to such intangible and immaterial processes of consciousness as the affections the physical power of "stamping-in" and "stamping-out" neural connections;—it is well known and generally accepted that the affections are extremely evanescent, intangible, and elusive, and immaterial processes of consciousness, and that they forbid being the direct objects of attention, besides being frequently absent when one's acts are either successful or unsuccessful. Thorndike (182) has been squarely opposed to the hypothesis known as the "ideo-motor" theory of voluntary action,—that such immaterial, intangible, evanescent, phenomena as "ideas," or images, serve to initiate, or to be connected in sequential fashion with movements of muscles. And, yet, it is almost universally conceded that affective phenomena are much more incorporeal, evanescent, immaterial, and elusive than images, ideas, and sensations. It is to these "psychical ghosts" of the affections that Thorndike has attributed such wonderful physical powers of "stamping-in" and obliterating connections in the human nervous system. And we are not alone in taking issue with Thorndike here. Peterson, a psychologist of strong behavioristic leanings, refuses (143, p. 159 f.) to follow Thorndike in regard to the rôle of the feelings or affections, in the acquisition of correct movements, and maintains that pleasantness is merely an indication that a certain response is "relatively complete, unimpeded" and "harmonious with one's inherited and acquired organization" of associations (with one's "apperceptive mass" in the terminology of a follower of Wundt).

The state of affairs would appear to be more the reverse of that suggested by Thorndike,—namely, that pleasantness were produced by and indicated the implanting or the establishment of associations,—that pleasantness were essentially a process of congruity or facilitation;²⁷ and that unpleasantness were pro-

²⁷ See Piéron's (149) conjecture that the feelings of comprehension and of familiarity may be sensations resulting from facilitation of cerebral functioning and that feelings of unfamiliarity and of obscurity may be sensations resulting from the inhibition of cerebral functioning. In this connection see also Herbart's discussion (73 and 48) of the facility with which ideas and images course through consciousness and the relationship existing between facile and impeded associations and the affections. The writer of this thesis has no apologies to make to Herbart and the Herbartians, since at the time of the reaching of our conclusions and the preparation of this paper we had forgotten just what were Herbart's contentions in regard to the affections; after the writing of this paper our attention has been called to the fact that our view is similar to that of Herbart, and, moreover, that this view has lately been taken over by some psychiatrists. If we owe

duced by and indicated lack of adjustment or the breaking of associations,—that unpleasantness were essentially a process of incongruity or of an impediment to facilitation. But this hypothesis cannot always be rigorously applied throughout the delayed recalls, for, in case it were always correct, the more accurate recalls should be accompanied with pleasantness, and the more inaccurate recalls with unpleasantness, at least in the earlier of the delayed recalls. Usually just such a state of affairs did not occur; the complete disappearance of affection, at least during the interval succeeding the learning and preceding the immediate recall, was quite pronounced. And this latter fact seems to add weight to the hypothesis that affection is only an incidental factor. Pleasantness or unpleasantness practically never once ushered a recall into consciousness. And, as forgetting increased in its extent, not a single case was reported in which pleasantness or unpleasantness constituted the sole remaining content of memory, or constituted the only residuum left behind by the process of forgetting.²⁸ In this connection, however, it is to be borne in apologies to anyone, it is to Wundt; but it is our belief that our view came from our own introspections and the introspections of our observers, and was not in any degree influenced by the Wundtian gospel of apperception.

²⁸ Abramowski (2, 3, and 4) contends that forgetting and the consequent filling of the lacunae of memory by false data, or by misplaced data, is actively resisted by the operation of a feeling. This feeling he terms a "generic feeling,"—for, in the original imprinting of a datum, a feeling is aroused by the impression, and this feeling fuses with the impression to constitute a perception. The original, or "generic," feeling belongs to that particular datum of impression by which it was at first aroused, or, rather, the datum belongs to or with its original or "generic" feeling. In the course of time, as forgetting progresses, the particular datum of memory is lost, but its "generic" feeling is never lost: "*Objekt vergeht, Affekt besteht*" (203, p. 151); it continues to exert an influence against forgetting,—it fails to fuse with an incorrect or false datum,—thus it resists forgetting. If this view conceives of the "generic feeling" as pleasantness-unpleasantness, our results fail to substantiate Abramowski; but if the term covers motor, organic and affective factors, together with the occurrence of certain attitudes, and the changing qualitative process aspects of mental contents, such for instance as temporal relations of rapidity and slowness, clearness relations and their changes, spontaneity and hesitancy, durability and instability, etc.—if the term is a general one, covering such phenomena, we shall have more to say in another section to substantiate Abramowski's claim.

mind that the observers were working under the *Aufgabe* to recall,²⁹ and hence the recalls were of the voluntary kind; and the fact that learning and recall attitudes, particularly the latter, may initiate a recall indicates that the *Aufgabe* was operative and that the observer voluntarily exerted efforts to recall. The facilitation of these efforts to recall would lead to pleasantness, no matter what the correctness of the recalled contents might be, and the failure of these efforts would lead to unpleasantness.

Pleasantness and unpleasantness manifested almost every possible relation with kinaesthesia of strains and tensions, and with increase and decrease of the extensity and of the intensity of strains and tensions. A feeling of pleasantness accompanied a total relaxation of strains and frequently attended merely a decrease of strains. At times the observer reported a feeling of pleasantness but no kinaesthesia whatever. And at still other times the observer reported that a feeling of pleasantness was accompanied by an increase of strains. On the other hand, the observer frequently experienced unpleasantness and no kinaesthesia whatever; and sometimes he reported that a feeling of unpleasantness was accompanied by a total relaxation of or merely a decrease in strains. And very frequently the feeling of unpleasantness was attended by an increase in strains. Moreover, strains and tensions, sometimes increasing and sometimes decreasing in intensity, were unattended by the feeling of pleasantness or of unpleasantness, and very frequently a total relaxation of strains or an experience of passivity was reported by the observer with no mention of either pleasantness or unpleasantness. All of these possible relations between affections and kinaesthesia were exemplified by every observer. In general, however, unpleasantness most frequently occurred in conjunction with kinaesthesia of strains and tensions, while pleasantness occurred most frequently in conjunction with a decrease or a total relaxation of strains and with what may be called a "passive attitude" or an "attitude of composure." The conjunction of pleasantness with strains, and of unpleasant-

²⁹ See Clark's treatment of this point (41, p. 481).

ness with a decrease of strains, sometimes regarded as unusual phenomena by adherents to the James-Lange view of affection and by more recent "behaviorists," is well shown by the following introspections from Observer *F.*:

Obs. F. Series II 2. Delayed Recall, after 89 days. January 17, 1916. "In the foreperiod, there were the usual strains. I then perceived visually that the experimenter was procuring a sheet of paper; vocal-motor 'that army thing'; then auditory perception of the stimulus, with pleasantness and a slight increase of strains."

Obs. F. Series II 3. Delayed Recall, after 356 days. January 10, 1916. "In completing my recall, I experienced in vocal-motor images the *Aufgabe*, 'guess that's all'; then there was a relaxation of strains and a slight decrease of unpleasantness; the unpleasantness continued for a while after the relaxation of strains."

As forgetting increased, affection played a more and more significant rôle in experiences of certainty and uncertainty, and of acceptance and rejection. In the earlier recalls it played an important part in certain attitudes. These two groups of phenomena, and the part played by affection in them will occupy our attention in another section of this paper (p. 113 ff.).

iv. *Conscious Processes and Procedures Involved in Logical Memory*

The discussion thus far has unavoidably anticipated certain results which belong under the above rubric. In the present section we shall discuss such topics as attitudes of consciousness (*Bewusstseinslagen*), subjective interpolations, acceptance and rejection, the differences existing between recall-associations and extraneous associations, and subjective assurance and lack of assurance. This list contains a comprehensive group of formidable topics; and one might object to their treatment in a paper of this length, claiming that these topics are side-issues to our main problem, and that they should merit treatment in a supplementary paper. They are procedures or factors of recall employed by every observer in his attempts to remember and in his attempts to resist forgetting. For this reason, if for no other reason, they deserve treatment in the body of this paper on an analysis of forgetting. Moreover, each and every one of these

processes suffered from the effects of forgetting, and indicated changes wrought by forgetting and by the lapse of time. In the third place, they occupy in their own right substantial places in what is known as one's *logical* memory and in one's attempts to logically recall and then to unravel the truly learned material from the spuriously and subjectively interpolated associative material. Lastly, and most important of all, *attitudes of consciousness* are largely the *functional, process* aspects of contents, a subject woefully neglected in psychology, especially in the psychology of memory and forgetting, and a subject to which the Würzburg psychologists and the imageless-thought psychologists have done great violence; it is our intention to show in this paper that such phenomena as clearness and variations in clearness, fluctuations of contents, spontaneity of the appearing of contents, suddenness and jerkiness manifested in the coursing of contents through consciousness, slowness and a vacillating aspect of contents, the failure of contents to appear at all, their departure to return no more, variations in the intensity of contents, and spatial aspects of contents, are all the *process, functional* aspects of consciousness which play such tremendous and such weighty rôles in memory, in forgetting, and in the logical efforts of the observer to weed the chaff out of his recalled contents.

Our treatment of these topics will adhere as closely as it is possible for us to make it adhere to the very words contained in the observer's introspections. The following excerpts from the original introspections will serve to introduce us to this most slighted field:

a. *Attitudes of Consciousness (Bewusstseinslagen)*

Surprise

Obs. B. Series II 3. Presented November 17, 1915. "Upon the presentation of the material, my visual perception was general and indefinite, and contained no more than a mass of colors; then a sudden kinaesthesia of raising my head, shoulders, arms, and back, with tension in my throat and vocal apparatus; incipient vocal-motor-auditory image of 'Uh!'; slight kinaesthesia of my eyelids narrowing as if a light were flashed in my eyes; unpleasantness; all this meant surprise."

Obs. F. Series II 3. Presented January 19, 1915. "In the foreperiod, upon the 'ready' signal, breathing was inhibited; I experienced strains in chest,

neck, and jaw; highly concentrated visual attention on the shutter. With the presentation came a general, indefinite, visual perception; strains increased; unpleasantness came in very rapidly, and vocal-motor 'Gee! is it possible?'; then a casual examination of the material."

Obs. Fg. Series II 3. Presented January 18, 1916. "When the material was presented, I visually perceived the masses of color and form in a general fashion; there was a sudden arrest of breathing and a vocal-motor 'My! what have we here?'; eye-fixation moved around over the material slowly."

Obs. Fs. Series IV 1. Delayed Recall, after 107 days. March 12, 1915. "Had been anticipating 'An Orator' in auditory imagery and in perceiving peripherally the green curtain; then focal attention was on the shutter. When the experimenter announced the stimulus ('Transmigration'),³⁰ there was a very focal auditory perception of 'Trans—', and before the experimenter finished the word, I was aware of a slight muscular rigidity all over my body and a holding of the posture; then there was practically a blank period in which only the word 'Transmigration' rang in auditory imagery of the experimenter's voice; only a dim awareness of the experimental surroundings; this was a state of being slightly dazed, and it lasted until visual attention turned to the place where the material had been presented."

Obs. O. Series II 2. Delayed Recall, after 49 days. December 9, 1915. While drawing a certain detail, the observer was surprised at the rapid appearance of another detail in visual imagery. "This latter detail was very focal and sudden; there were strains in my neck, and my breathing was inhibited; then a vocal-motor 'strange that it didn't come in before.'"

Obs. R. Series III 1. Delayed Recall, after 14 days. March 15, 1915. "I didn't expect the instructions so soon; tensed state came when the experimenter said, 'I want you to recall—'; I had been passive before that; vocal-motor 'here comes the assignment!' The sudden tension and quick attitude to listen to the stimulus (a turning of my ear to the experimenter and the focality of the sounds) were my experience of surprise."

Obs. T. Series I 1. Presented April 1, 1915. "Had been visualizing the color circle material; was restless, with inhibited breathing and unpleasantness. On the presentation, with the first general vague visual perception, my whole body was drawn back, and my breath was drawn in; I do not recall any unpleasantness, but I had vocal-motor 'Well, that'll be difficult to describe!'; a drawing back and a shaking of my head."

Obs. W. Series I 1. Presented November 14, 1914. "Immediately on the presentation I experienced surprise; a sudden and rapidly increasing tension in shoulders and face; there was a focal perception of the material as foot-

³⁰ This material was a selection of philosophical prose treating the doctrine of transmigration as taught by the Pythagoreans and opposed by Aristotle (see footnote, p. 109). In the recalls the experimenter in oral fashion gave instructions for the observer to recall "Transmigration."

ball; my line of regard suddenly moved to the football player's right leg, to his sweater, and to his trousers; then there was a sudden definite and clear auditory-vocal-motor 'football.'

Disappointment

Obs. O. Series II 3. Delayed Recall, after 95 days. March 12, 1915. "In recalling a quadrant of the colored circle, vocal-motor-auditory imagery of 'yellow' came immediately, but nothing came in the visual image; kinaesthesia of eyes up to upper right quadrant; this was a very clear white blank and nothing came to fill it; here I experienced disappointment, unpleasantness, close attention to the visual image, deep inhibition of breathing, frowning with strains around my eyes, forehead, and face, and vocal-motor-auditory 'I thought I knew this one—did not know the last quadrant.'"

Amusement

Obs. Fs. Series III 1. Presented April 17, 1915. "With the presentation, I caught sight of the four persons ('Bringing-Up Father') and immediately there was a clear emotional reaction of amusement; instead of focusing on the pictures and trying to learn them, I was aware of large parts of the material all at once with no details present, and attention did not remain at any place very long; visual perception was not clear and there was no concentration of attention; focal set of kinaesthesia, of smiling and of turning to the experimenter as if wanting him to look at the material; raise of eyebrows and squinting in smiling; slow inhibited breathing; and pleasantness."

Obs. R. Series III 1. Presented March 1, 1915. "When the experimenter raised the shutter, there was an instant before the pictures were clearly perceived; then a becoming clear of the pictures in visual perception; and a visual perceptual and vocal-motor reading of the caption; smiled at the name 'Rubes de Gink'; vocal-motor 'Hotel de Gink'; pleasantness and a relaxation of general bodily tonus."

Obs. T. Series III 2. Presented October 14, 1915. "Visual attention was fixated on the white card at the top (caption card bearing a heart, a diamond, a spade, and a club), with successive fixations on the heart and the diamond, and vocal-motor-auditory naming at each place; the same sort of procedure for the spade, the club, and the title 'Poker Shark.' This procedure went on easily without any hold-up of attention, and there was pleasantness. Background caught attention, and then attention shifted below, my eyes going over the picture at random, stopping at different details; there came in strains in speech organs and a restlessness and eye-movements; the strain increased; and then suddenly vocal-motor-auditory 'Van Loon!—Pa Van Loon!' with pleasantness and a facial expression of humor (wrinkling of face and squinting of eyes, with a smile)."

Obs. W. Series I 1. Presented November 14, 1914. "After visually perceiving the football player who seemed to have three legs (another football player was behind the larger one giving the appearance perhaps of three

legs), I had a visual image of a football player with three legs on the field; visual images of biological sports; pleasantness; actual kinaesthesia of smiling and a rhythmical, periodic contracting of my chest muscles."

Excitement

Obs. F. Series I 1. Immediate Recall. November 17, 1914. "The empathic kinaesthetic imagery of feeling myself kicking was very intense and clear, and there was great pleasantness. Besides the actual kinaesthesia here involved and its intensity and its great clearness and an experience of pleasantness, there were the factors of concentrated kinaesthetic attention, inhibited breathing, and a release of the general bodily kinaesthesia not definitely located;—all these constituted a feeling of excitement."

Obs. Fs. Series V 1. Delayed Recall, after 7 days. January 13, 1915. "In the foreperiod there was an auditory perception of the instructions 'to attend to my first conscious process'; after this, the clearness relations of visual perception shifted to the visible parts of my own body, and to a kinaesthetic awareness of my bodily position; slight increasing tenseness; all of which processes seemed to constitute an experience of excitement of having something to do."

Obs. O. Series V 2. Delayed Recall, after 38 days. June 7, 1915. "After perceiving the stimulus to recall, 'Gym' (mannikin posture), I experienced kinaesthesia of moving my head toward the curtain; then came an indefinite visual image of a brownish figure; continued vocal-motor-auditory 'Gym'; gradually the visualized brown figure took the position of the 'Gym' statue over in the corner where it had been presented; vocal-motor-auditory 'O, yes!—I remember it now!'; accelerated breathing and an organaesthesia of a rising and a falling of my internal organs."

Obs. T. Series I 1. Delayed Recall, after 305 days. January 31, 1916. After the stimulus to recall 'Kick-Off,' the observer had a veritable play of visual images, which were schematic, vague and non-intensive and contained very few details. "Finally one of the visual images began to persist; it stayed; and throughout this whole experience, from the stimulus to this persistent visual image, there was a bodily attitude of excitement, consisting chiefly in a trembling and a restlessness in my legs, although the shifting of the visual images played a part in the excitement."

Obs. W. Series I 1. Presented November 14, 1914. "An empathic experience of watching a football game; this experience consisted of faint kinaesthesia and organaesthesia in the region of my diaphragm, and of increasing pressure in my chest extending toward the throat. Visually perceiving the player's right leg in the air, I experienced a kinaesthetic image of myself kicking a football; this was intense but short-lived; the organic, kinaesthetic, respiratory and circulatory factors made up my excitement."

Delight

Obs. Fs. Series V 1. Delayed Recall, after 7 days. January 13, 1915. "Suddenly there came a very distinct visual image of a table on which 'An

Orator' stood with the caption-card tacked to the front of the table; a sudden intake of breath; a tendency to smile; and pleasantness;—all of these processes were involved in this attitude of delight."

Disgust

Obs. S. Series V 1. Presented January 7, 1915. "When the mannikin was exposed to view, I merely glanced at it; then I had a visual image of a cadaver on which I had worked in my medical course; this visual image was remarkably clear, and the whole experience was toned with great unpleasantness; there were kinaesthetic and tactual images of my hands on the cadaver; olfactory images of carbolic acid and of formaldehyde; tactual and thermal images of the cadaver's hardness and coldness; then I experienced a general feeling of depression, of inhibited breathing, of a moving and sinking of my internal organs, of nausea, and of a choking in my throat."

Obs. S. Series V 1. Immediate Recall. January 7, 1915. The observer had lived over again in this recall his learning experience; he had a visual image of the statue; he assumed empathically the statue's posture and visualized himself in that posture, and had tactual and kinaesthetic images of running his hands over the smooth surface of the statue. "There was great unpleasantness; a jerking of my head and neck; a jerking of my internal organs and nausea."

Obs. S. Series V 1. Delayed Recall, after 7 days. January 14, 1915. "When I visualized the mannikin's chin, I experienced a peculiar feeling which was extremely vague; then a visual image of a man with no chin at all appeared; a feeling of nausea and of unpleasantness; this peculiar feeling cleared up somewhat, and I was aware in kinaesthetic and visual imagery of bending over a cadaver; the unpleasantness was intensive."

Awe

Obs. Fs. Series IV 1. Presented November 21, 1914. "With the visual perception of the words 'transmigration of souls,' there was an organic and a kinaesthetic experience, an attitude, typical of one starting to ask 'is it not wonderful?'; an intangible and vague setting of my mouth for an 'Oh!' and a kinaesthetic image of exhaling for that expression of 'Oh!'; a general bodily tonus, organic and kinaesthetic, characteristic of an awe-struck attitude."

Dismay

Obs. B. Series I 1. Delayed Recall, after 82 days. February 2, 1916. "These two visual images (of two football players, one of them facing the observer's left with left foot upraised, and the other player facing the right) alternated in clearness and shifted in positions; it was literally as if the two were trying to push each other out of consciousness; and accompanying this fluctuation, vocal-motor-auditory 'goal?—no;—Kick-Off—which?'; and then an experience of dismay which consisted of slight unpleasantness, a consciousness of general bodily strains and tensions, and the fluctuations which the visual image underwent. It was just as if I were dismayed and sat here watching the conflict of the visual images."

Wondering

Obs. B. Series CI 5. Delayed Recall, after 21 days. February 9, 1916. There had been a confusing play or fluctuation of visual images; these images contained varying contents and they overlapped one another and fluctuated. "Eye kinaesthesia of looking from the goal posts to the player who was in the foreground of one visual image and then came other visual images of previous experiments; and then a wondering if I had confused the 'punter' picture with the 'goal' picture; this wondering consisted in a fluctuation of the visual images, in vocal-motor-auditory alternations of 'punt' and 'goal,' and 'were there two?—I wonder?'; and still I sat passive, except for slight strains and tensions, not accurately digging the material out, just passively experiencing the play of the visual images."

Obs. Fs. Series IV 1. Delayed Recall, after 21 days. December 16, 1914. "Upon the stimulus to recall 'Transmigration,' there came a starting of a consciousness which would have developed into a consciousness of wondering; the word 'Transmigration' lingered in auditory imagery; vocal-motor 'Why?—,' with a setting of my mouth for that question."

Obs. T. Series CI 4. Presented January 13, 1916. "My wondering, whether he was kicking the ball or whether he was just catching it, consisted of the concentration of my visual attention in perceiving the ball, and in the vocal-motor expression 'he could not catch the ball in that position,' and several other expressions similar to this one, while attention remained on that particular position of the player. Finally, there was the consciousness that he had just dropped the ball in order to kick it; this consciousness consisted of my visual perception, a drop of my eyes from his hands down to the ball, and then no further attention was paid to it; my attention turned to something else."

Confusion

Obs. B. Series I 1. Delayed Recall, after 7 days. November 19, 1915. "While I was vocalizing my recall to the experimenter, my attention was concentrated on a visual image of a white square of paper which bore the caption 'Kick-Off,' which kept coming in, now in one position, now in another position. This shifting and vacillating made up a consciousness of confusion."

Obs. Fg. Series III 1. Delayed Recall, after 105 days. February 1, 1916. "The visual image was vague and indefinite, and did not stand out distinctly as a whole, but there was a fusion of details in the visual image and this fusion was somewhat of the nature of a composite picture or a picture superimposed upon another picture; attention alternated between visual images of this picture and of the title; and the whole experience was one of confusion."

Obs. Fs. Series IV 1. Delayed Recall, after 107 days. March 12, 1915. "The words came in vocal-motor-auditory terms and I repeated them four or five times, some of the words changing at each repetition; these images were interspersed with periods of mental blanks in which there was no clear

process except a slight, dull, diffused compression in my head. These experiences of mental blanks and the compression in my head were the components of a consciousness of confusion."

Obs. O. Series IV 2. Presented October 6, 1915. "As I read the words of the material in terms of visual perception and vocal-motor-auditory imagery, there occurred a state of confusion, consisting of a consciousness of brain activity (which I cannot analyze better than this,—whether compression or not I cannot say); frowning and kinaesthesia of my head moving back and forth spasmodically; and no definite imaginal content although there were incipient tendencies to vocalize."

Obs. R. Series IV 1. Delayed Recall, after 25 days. April 12, 1915. "In beginning my recall there was an experience of confusion, a kind of mental blank; and then my attention turned to the vocal-motor 'Well, is this transmigration?'; and then there came a confusing mass of very indistinct visual images of different titles and materials of previous experiments."

Obs. S. Series II 3. Delayed Recall, after 42 days. April 15, 1915. "After the instructions were given to recall the 'color circle,' I had very vague visual images of the color wheel which became clear gradually, and motor concomitants of these confused and vague visual images; tensions in my face and around my eyes; there was no clear awareness of any particular detail of the visual image, but there was a more general bodily reaction to many details which were very rapidly fluctuating in the visual images; these visual images were fitting and evanescent in character. Before the images cleared up, there was an auditory image 'What are those colors?'"

Obs. T. Series V 2. Delayed Recall, after 39 days. January 24, 1916. "On hearing the stimulus ('Gym'), I experienced without any other antecedent process a quick kinaesthesia of my head and eyes being turned toward the corner of the room where the mannikin had been presented, and on the background of the visual image a sort of squareish thing cleared up; no words as such were on it, but this schematic content functioned as the caption of the material; it came just after the title-stimulus had been given by the experimenter and was located at the place of the original presentation of the caption, and my attention held on it for a brief interval of time; my attention then left the caption, and in terms of kinaesthesia of head and eye-movements, attention went to the visual image field in front of me; there was a period of delay and confusion; no processes and a kind of mental blank except for kinaesthesia of inhibited breathing accompanied with some unpleasantness. Then there came kinaesthetic and visual images of my legs being turned around; these images were not completed, for in the course of their appearing a localized visual image of the mannikin popped into consciousness."

Doubt

Obs. B. Series III 1. Delayed Recall, after 14 days. October 29, 1915. "My attention went to the left-hand figure (the son-in-law of the 'Bringing-Up-Father' group of pictures) in the visual image, and there was a shifting

of lines in this visual image; besides vocal-motor processes, there was a complex of doubt; this partly manifested itself in my visual image by the shifting of the lines of the picture; kinaesthesia of strains, of restlessness and of alterations of breathing; unpleasantness; and my attention went to this picture slowly and remained on it only a short time, that is, the visual image did not remain distinct, and my bodily attitude changed to an attitude of relaxation and of little or no effort, while my attention went to the experimenter and to recalling the material to him."

Obs. F. Series CI 5. Delayed Recall, after 21 days. December 13, 1915. "A series of vocal-motor processes which were accompanied by motor images of changes of my bodily position and changes of orientation; the vocal-motor images were very syncopated and they were expressions such as 'was it this leg? (my right) or the other one?'; 'was he kicking up there?—or lower?' 'No; lower is goal from field, and this goal—must be punt';—'Was he facing the other way?' and here a change of my bodily position; 'No; not this way—both players face the other way,' and then a change of my bodily position back to the original posture. The processes followed each other very rapidly and I was aware non-focally of developing strains in my chest, abdomen, and head, and a very slow and shallow breathing, and also of slowly increasing unpleasantness which finally reached a high degree of intensity. Then I was again focally aware of my original bodily position (facing left and right leg kicking); a great decrease of strains and of unpleasantness, and a resumption of normal breathing; all of these processes apparently meaning acceptance."

Obs. Fg. Series III 1. Delayed Recall, after 11 days. October 30, 1915. "There was doubt as to who it was in the picture who was winking his eye (father or son-in-law of the 'Bringing-Up-Father' group of pictures); this doubt consisted of a visual image of the old man winking, and then of the young fellow winking, and then an alternation between these two visual images; a kinaesthetic image of pointing my left arm toward my left side and, thereupon, the visual image of the young fellow persisted (this picture of the young fellow was on the observer's left); my attention turned to something else—to auditory images of myself reproducing the material to the experimenter, and thus terminated the experience of doubt."

Obs. Fs. Series I 1. Delayed Recall, after 94 days. February 13, 1915. There was doubt as to which leg the football player was standing on. "When I came to describe that part of the picture my attention went to the hip region of the football player which was indefinite in the visual image; the image was shifted so that he stood on his left leg; attention then was just on the point of turning to a vocal-motor-auditory description of that leg with an accompanying slight relaxation of tensions, when there occurred a shift in the visual images so that the player was now standing on his right leg; vocal-motor-auditory 'he must have kicked with his right leg'; immediately in the visual image the player resumed the position of standing on his left leg; here the recall halted; I visually perceived the experimenter and his table and my visual images of the football player vacillated and there was tension in my forehead; all this comprised a consciousness that previously

I had had difficulty at this point of my recall. There was no affection present, but the doubt consisted in the slowing down of my recall-processes, in the vacillation of these processes, and in a slight tension throughout my body."

Obs. O. Series IV 1. Delayed Recall, after 422 days. January 19, 1916. "When I started to recall I had a visual image of a card which was localized on the shutter where it had been presented, and the first word on the card was indented; on the card there was a mass of gray,—I could not tell whether the word was printed or written by hand. The words came very slowly, the auditory images preceding the vocal-motor especially in cases of important words. The word 'souls' came slowly and in a developing fashion and was emphasized in vocal-motor-auditory imagery when it did come. My doubt consisted of the slow appearing of the auditory-vocal-motor processes, the indefinite manner in which the details were localized (they were indistinct and wobbling in the gray of the visual image), and a vocal-motor-auditory hesitant question 'is it — —?'"

Obs. S. Series II 3. Delayed Recall, after 42 days. April 15, 1915. "In recalling the fourth quadrant of the color circle, I was not aware of any relaxation of strains; my attention left this quadrant for a visual image of the first quadrant, and during this shift the visual image of quadrant four tended to insert itself; finally, the fourth quadrant shot itself into consciousness in full force and remained for a while; there were rising tensions throughout my body and increasing unpleasantness. The vacillation of my visual images, the holding of my attention on the fourth quadrant, and the increase of strains with unpleasantness were involved in my experience of doubt."

Obs. T. Series I 2. Delayed Recall, after 18 days. November 8, 1915. "My doubt as to what were the letters and their colors in the caption of the material consisted partly of an indefinite visual image; when the visual image was present I was at no time conscious of color; even this indefinite visual image disappeared from consciousness and there was a complete turn of my attention to the act of expressing my recall to the experimenter."

The foregoing introspections show that there were certain characteristic conscious experiences which manifested a composite or a complex nature. The complex was not a mere juxtaposing of separate conscious processes, nor was it a mere succession of separate conscious contents and conscious events. All of the parts were fused and unified into one unitary reaction of consciousness to the situation in hand. One was able to analyze out some of the constituent elements, but to find the unifying factor or the unifying principle, if there was one,—that principle which bound these separate processes into one, active, dynamic reaction of consciousness, was near an impossible task.

These attitudes, as we may call them, can be classified into the following groups: surprise, disappointment, amusement, excitement, delight, disgust, awe, dismay, wonder, confusion and doubt.

Surprise was characterized essentially by the suddenness of the appearing or the disappearing of a mental content or the suddenness of some functional change in a content; this phenomenon of a sudden variation in the flow of conscious processes was always manifested in experiences of surprise. And very closely related to this sudden functioning of mental processes there frequently occurred, as an integral constituent of the attitude-complex, some kinaesthetic phenomenon indicating some bodily adjustment, indicating the occurrence of some *Einstellung*; this bodily component itself usually,—perhaps it is not unwise to say always,—was characterized by suddenness in its onset and oftentimes in its termination. The kinaesthesia here involved was constituted of strains and tensions and rigidity of bodily members. Many accompanying phenomena, very often varying in kind and in amount, included such states as vocal-motor-auditory exclamations and questions; eye-movements of a wandering, restless kind; inhibited breathing; high concentration of attention; mental blanks and experiences of being dazed; haziness of content, often followed by the coming of definiteness; and unpleasantness, which, we are tempted to say, always occurred either in slight or intense degree just at or just following the sudden and unheralded variation in mental processes and was due, in our opinion, to this sudden breaking of the dominant flow of processes. This last statement does not deny that there may have been experiences of surprise, which looked at *in toto* or *post hoc*, were dominantly pleasant,—and what we say of unpleasantness has to do with the analysis of the state of surprise itself and not some after-event in consequence of or due to the state of surprise. It was very probably true that adjustment to the change or variation in contents, when completed or when well under way, was conducive to pleasantness; or, it was likely that the variation in contents just succeeding its onset, that is, when the new content, or the change in function, had attained a

duration, or had the right-of-way in consciousness following its sudden emergence, was then followed or accompanied by pleasantness, this experience depending in no small part upon the fitting-in, or the facilitation, or the completeness of response, of the newly arriving content or changed function of content. If this were true, namely that the congruity of the incoming content with the already existing state determined the degree of pleasantness present, our analysis of the state of surprise has not been invalidated; a pleasant surprise is a possible and a frequent event in one's mental life.

Disappointment consisted essentially in the slowing down, or the complete inhibition, or cessation, of one's mental contents; the observer frequently described the experience as being one in which no images occurred, no process came,—the observer said 'nothing came.' Another invariable constituent of the attitude of disappointment was unpleasantness. Besides these, we discovered many variable forms of kinaesthesia, ranging from intense strains to complete relaxation, and inhibited breathing. Often there occurred slow, hesitant, and doubtful vocal-motor-auditory expressions, remarks and descriptions of the learning and recall materials, etc.

Amusement was a highly complex attitude. We may say at once that amusement always manifested pleasantness and kinaesthesia of smiling or of relaxing the general bodily tonus or of squinting the eyes. On the conscious side there was very little concentration of attention; the observer was aware, either in perception or in imagery, of whole masses of details of a presented material,—there was no analysis,—the perception was a general one rather tending toward unclearness. Attention constantly shifted. Many times there were vocal-motor-auditory exclamations and ejaculations of various kinds. These constituent processes of the amused attitude made their advent in consciousness rather suddenly, and their coursing through consciousness was attended with rapid and sudden shifts.

Excitement was characterized by an excessive amount of intense and clear kinaesthesia. This kinaesthesia may have been

that kinaesthesia incident to relaxation or to tensions of various sorts,—it may have been that of a rising and falling in the internal organs or that of accelerated breathing. There was often present also some visual, perceptual or imaginal awareness of the observer's own body. Whatever images occurred were very shifting in course, partaking of the nature of the restlessness which characterized the general bodily condition at the moment.

Delight was constituted in large part by the suddenness with which some content entered consciousness; this, however, alone did not give a consciousness of delight,—the contents had to be distinct,—there had to be pleasantness,—there had to be some bodily relaxation or decrease of tensions, as in smiling. Many experiences of delight had also a component of inhalation.

Disgust, on the contrary, manifested, first of all, extreme unpleasantness and a kinaesthesia of general bodily depression; there was a rising and falling of the observer's internal organs, nausea, a choking in the throat, inhibited breathing, etc.

In an attitude of awe the observer wore a startled, half-frightened expression, and experienced kinaesthesia and vocal-motor-auditory imagery of asking some question, or of being in a mood to ask a question. There was a poverty of mental contents other than those that we have described, and the observer's attention did not readily shift, although there was no intense concentration; attention here was extremely diffuse. The state was very similar to what we have in many places called a "mental blank."

The consciousness of dismay was a complex which included many factors highly fused together;—there were a great many fluctuations of whole contents, or if the contents did not fluctuate as wholes, there were numerous shifts and alternations in clearness, and the processes shifted their spatial localizations. The observer exhibited, in his speech kinaesthesia or in verbal images, a questioning inflection, a slow sort of hesitancy. There was unpleasantness, which varied from a low degree to a high degree of intensity. There were a great many strains and tensions of a depressed, inert kind of bodily attitude or *Einstellung*.

Fluctuation of imagery, with much overlapping and confusion

of details, was a chief characteristic of the attitude of wondering. Present also with these fluctuations were alternating and wandering eye-movements, slight strains and tensions of a sort of holding-oneself-in-check, or a sort of slight restraint. Except for these slight strains, the observer was comparatively passive. There was much vocal-motor-auditory alternation and questioning.

Confusion exhibited a great quantity of fluctuating contents, with frequent repetition of processes, which continued ever to come and go. Very frequently the contents were characterized by vagueness and indistinctness, and at times they seemed to be superimposed one upon another into a puzzling mass. Attention underwent much fluctuation. There were many mental blanks and a great quantity of unpleasantness. The motor phenomena of this attitude were frowning, inhibited breathing, compression in the head, vocal-motor questioning, etc.

Doubt was very similar in nature to the attitude of confusion. The chief difference between the two lay in the fact that while in confusion there was a profusion of contents, which were vague and shifting, but no cessation or hold-up of consciousness, in doubt there was a haltiness, an impeded flow of conscious processes. Doubt showed shifting contents, kinaesthesia of strains and restlessness, unpleasantness, the holding of attention on the content at hand and the slow advent of the content which followed. Besides the factors here enumerated there were synco-pated vocal-motor-auditory images, in a questioning inflection, and the observer's bodily attitude finally passed into one of passivity and inertness.

The Würzburg psychologists³¹ and their adherents in this country³² have been champions of a so-called "imageless thinking" and an assumed "thought element." It was they who isolated and described the conscious attitude, which has been variously termed *Bewusstseinslage*, *Bewusstheit*, *Wissen*, and

³¹ Külpe (87 and 88); Marbe (104 and 105); Mayer and Orth (109); Orth (136); Watt (199, 200, 201 and 202); Ach (5); Messer (113); and Bühler (32).

³² Notably Woodworth (212 and 213) and Ogden (132, 133 and 134).

Stellungnahme.³³ The attitude of consciousness has been supposed by these psychologists to be unanalyzable, and, being unanalyzable, it of course was thought to furnish ample evidence of the existence of another element of mind other than the three orthodox elements of sensation, image, and affection; and, being unanalyzable, it lent itself in a capital fashion to the use of logicians and metaphysicians and transcendental philosophers and psychologists, who have always been disposed to find in mind pure elements of willing, of reasoning, of thinking, of self-activity, etc., elements of a psychical universe or a world of ideas and psychic entities.

The writer of this paper has been led by his own introspections, extending over a period of three years, and performed in a laboratory of psychology where introspection is rigorously and systematically done and where one's introspections are of little value until one has attained considerable practice and facility in introspecting, and by the introspections of his colleagues and his observers, extending over the same period of time, to the view that attitudes can be analyzed with fair thoroughness and in detail. Section B iv, pages 94 to 106, of this paper is devoted chiefly to analyzing many conscious attitudes, and to showing that there are many conscious processes, constituted of both contents and functions, which the Würzburg psychologists have entirely ignored or have entirely missed in their investigations³⁴ of the thought-processes and to pointing out just wherein these psychologists have failed to do justice to the phenomena under investigation.

³³ A term coined by Müller-Freienfels (125, 126, 127 and 128).

³⁴ It is interesting to note in this connection that an investigation by Betts (25), entitled "The Distribution and Functions of Mental Imagery," has been criticized in a seemingly just and pointed fashion by Miss Fernald (53). This work by Betts attempted to prove the existence of "imageless thought" and also to show that all imagery is irrelevant; and in Miss Fernald's opinion (and in the opinion of the writer, these opinions being based on a mass of literature concerning mental imagery and upon our introspections and the introspections of our observers), Betts's investigation fails in a great many instances to hit the mark and in other instances far oversteps the mark; and, yet, a quantitative and statistical and objective study should be, *a priori*, the most reliable sort of an investigation one can do.

b. Subjective Interpolations. When, in the learning, the observer misperceived some detail or details and failed to correct the erroneously perceived detail or details, the error continued to make its presence felt throughout the recalls. In the course of time, however, the erroneously perceived details manifested in themselves certain effects of forgetting similar to those undergone by the more correctly perceived data of learning. If, however, the observer obtained an inkling that his perception was incorrect, and if he endeavored to correct it, this awareness of error, and this endeavor to correct erroneous details, exhibited certain effects throughout the recalls. Observer *W.* continued to recall, in visual imagery, the picture of a football player to one of whose legs was attached a picture of a third leg, but he was always careful to state that "It *looks like* a third leg pasted there." In reality it was a smaller football player partially hidden by a larger player in front of him. A club and a spade of the caption-card of the "Pa Van Loon" picture (Series III 2) was continuously after the immediate reproduction recalled by Observer *F.* as black, whereas the details were actually green and in his immediate recall the observer had stated that they were green. In this connection, it is necessary to state that the observer never recalled the processes or procedures by means of which he obtained a given perception or a given imaged datum. This fact is in accord with Finkenfinder's (55) finding that procedures which had been employed in solving problems were never recalled; it should be mentioned, however, that Finkenfinder's instructions assigned to the observer the task of recalling his past attempts to recall that material. Our observers employed throughout the various experiments certain modes of recall which bore striking similarities; the fact of great similarities between the modes of recall after various intervals of time does not, however, mean that our observers recalled the various methods which they had in previous experiments employed in reproducing the material. This fact was particularly evident in the recalls of a selection of philosophical prose, consisting of two sentences, the second sen-

tence being in the nature of a refutation of the first sentence.³⁵ The observers did not recall their various attempts and procedures to understand the relation between the two sentences of this selection. If additions were made by the observer, that is, if the observer injected subjective elements into the presented material, these were usually recalled; this process of injecting subjective elements into a recall and of subsequently reproducing the injected details led always to constructions and falsifications of content, etc. In learning the football picture "Kick-Off" (Series I 1), Observer *F.* noted in terms of visual perception and vocal-motor-auditory images that the player really was not kicking-off but was really punting. And this remark never failed to recur in his subsequent recalls. In its first occurrence it was accompanied by unpleasantness and a considerable amount of forceful inflection; but in the later recalls, it took on quite a mechanical and rote character, tending to occur upon the perception of the instruction to recall "Kick-Off." This process of subjectively adding details to a material and then of subsequently reproducing these details occurred with Observer *F.* in the noting and recalling of a football picture entitled "Spiral" (Series CI 3) which he called "drop-kick," and with another football picture captioned "King of Punters" (Series CI 4) which this observer described as a picture of a football player drop-kicking. The picture captioned "Goal" (CI 5) this observer called "punting." Observer *F.*'s experience in dealing with these football pictures contained components of two widely different sorts; a component which *F.* received in relatively passive fashion from the content of the picture with its caption; and a component which he himself contributed,—the latter component being a product of his own critical reaction to the discovery that the content of the picture did not conform with its caption. And it was found that the "discovered" or "added" component was remembered

³⁵ Series IV 1 (hand written; title in red, rest in black):

Transmigration

The Pythagorean doctrine had implied that any soul may migrate to dwell in any body. To this Aristotle retorts that skill in carpentry does not imply ability to play the flute.

more accurately and more fully than the "received" component. This phenomenon is in accord with a finding which has recently been reported by Claparède (39) that if pairs of ready-made associations are presented to the observer he does not remember the second member of the presented pair nearly so well as he recalls the second term of the association which he has himself made. Claparède is perplexed to find an explanation for such a state of affairs. It would appear that the self-made or subjective association, on account of its subjective and associatively organized nature, would naturally be stronger than the association artificially presented by the experimenter,—particularly so when the subjective association comes in to share or to monopolize the attention which would ordinarily be consumed in the noting or learning of the presented association. Herbart (48, p. 35) had in mind a similar idea when he stated that "As a general rule, the ideas coming from within are, by virtue of their established connections more potent than the single new percept, especially since the latter diminishes in power as its stimulating effect subsides." Instead of receiving a maximum of attentive noting, the artificial association receives much less; further than this, the older or the subjective association receives in a degree a re-noting. Jost (81) has shown that of two associations of equal strength but of unequal age, the reproductive tendency of the older association can be more easily strengthened than that of the younger association. He employed the *Treffer-Methode*, and by selecting syllables which were not presented at the same time but which gave approximately the same *Treffer-time*, he was able to determine that with an added presentation or an additional learning a greater number of the older syllables were reproduced than of the newer syllables. The corollary would apparently follow from Jost's results,—namely, that the younger of two equally strong associations is in the course of time more easily forgotten. Ribot (159) has a similar conception in his law of regressive forgetting, in which he maintains that forgetting proceeds by way of the details or the particulars of a residuum of memory toward the more fundamental generalities of the memorial content. In our view, this means

that the age and the greater organization of the general features of a content give them a survival capacity greater than that of the more newly and less well organized details. And the view of retroactive amnesia, presented by Burnham (35), is in accord with the above-mentioned phenomenon,—the newly acquired and less organized data of impression are the more likely to suffer in the process of forgetting.

Even after forgetting had progressed to the point where Observer *F.* was unable to recall the material asked for, he never failed to recall the one fact that "the player was not doing so and so, but was doing something else." Our instructions included a stimulus to arouse the recall of a particular material, that is, the caption was orally called out to the observer. The fact that the stimulus or caption was orally given in each recall by the experimenter offers a state of affairs unlike that operative in Claparède's experiment. In his experiment it was found that an artificial word-association was forgotten in favor of the observer's own constructed association; but in our experiment the reagent did not entirely forget the presented caption (which would be analogous to the artificial word-association in Claparède's experiment). The similarity of results, however, is to be found in the fact that the football pictures which were associated with certain subjectively interpolated captions were forgotten, while the inserted or injected captions were remembered. And, as we have stated in an earlier section of this paper, (p. 47f.), these subjective interpolations (or injected captions) led to erroneous recalls of the material after long periods of delay and after the progress of forgetting had attained large proportions. The erroneous recalls of Observer *F.* show that in terms of empathic attitudes he inserted or injected certain of his own associations which were not in the original material; while Observers *B.* and *O.* tended to visualize certain details and certain newly constructed features which were not present in the original material but which were suggested by the original caption of the material. *B.* went so far as to visualize a spiral, metallic, spring when she attempted to recall the material (a football picture) entitled "Spiral" (CI 3); and, in recalling the material (a football

picture) whose caption was "Goal" (CI 5), she visualized goal posts on a football field and the players in different bodily attitudes. In recalling the material of Series III 2 which was captioned "Rubes de Gink," Observer *O.* visualized a common tramp seated by the roadside; this material had originally contained only pictures of the people of the "Bringing-Up Father" cartoons and had been labelled "Rubes de Gink" by the experimenter.

The more or less extraneous commenting remarks employed in the earlier recalls tended very quickly to disappear. An example which illustrates this phenomenon occurred in the recalling of the philosophical prose captioned "Transmigration" (IV 1). The observer never recalled his various remarks concerning the relation or lack of relation between the two sentences.³⁶ But if certain relations were perceived or conceived to exist between different parts of a material, these relations always tended to be recalled. New constructions of details and interpolations by the observer of features which were not present in the original material followed the line of the recalled relations, that is, a recalled relation was an easy point of entrance for subjective additions and distortions of content, such for example were additions of overcoat and high hat to the men in the picture "Rubes de Gink" (father and son-in-law of the "Bringing-Up Father" group III 1) who were really attired in evening dress. In learning the picture captioned "Rubes de Gink," Observer *Fg.* in verbal terms described the son-in-law (of the "Bringing-Up Father" pictures) as a "dude"; and in long-delayed recalls this observer began to visualize the son-in-law as attired in a loud suit of checked clothes, thus following the line of association which was made possible during the presentation by his calling the son-in-law a "dude"; in the original material "son-in-law" was not attired in checked clothes but in evening dress.

Objects, places and events, which had been suggested by the caption and its accompanying material on the original presentation and in the earlier recalls, tended to disappear as time elapsed; that is, the later recalls were less and less characterized by the entrance of associations suggested by the caption or by

³⁶ See footnote, page 109.

the nature of the learning material. Long delayed recalls, characterized by a weakened condition of associative bonds and by an increased disconuity of content, exhibited, on the other hand, a great profusion of the associations which had attended the original noting of the caption and the learning material. It was just the weakness of associative bonds and the disconuity of content that permitted the entrance of these suggested associations; but the fertile soil for their arousal had been laid even as early as the presentation. Examples of suggested associations, of the kind that we have been discussing, are: visual images of the Harvard stadium; visual images of football games; visual images of players; visual images of comic Sunday newspaper supplements (from which Series III 1 and 2 had been taken); visual concrete and visual and vocal-motor-auditory verbal images of text-books on philosophy; and visual images of philosophy lecture rooms (with the materials of Series IV 1, 2, and 3, all dealing with philosophy). All of the facts here mentioned, namely that the observer in noting the material presented to him added associations from his apperceptive storehouse of past experience,—he added elements to the material which were not objectively present,—that he then recalled these added associations for a short period of time following the presentation, and that they exerted a very strong influence in bringing to life distortions of content and additions of data in recalls after long periods of delay when the dissociated and weakened contents were most susceptible of distortion and falsification,—all these facts are closely related to those reported by Claparède,³⁷ and they lend support to the conceptions advanced by Jost, Ribot, and Burnham.³⁸

c. Acceptance and Rejection. Introspective descriptions of one's mental processes and one's mental contents when made in an undetailed fashion lead very easily to the view that an observer experiences a specific act of accepting or of rejecting a datum of memory as correct or as incorrect. Introspective accounts of one's mental behavior oftentimes include little more

³⁷ See this paper, p. 110 f.

³⁸ See this paper, p. 111.

than *Kundgabe*, or statements *about* one's mental phenomena,—information roughly referring to one's processes of consciousness rather than *thoroughly describing* them. And it is introspective evidence of this kind that so often and so readily lends itself to the notion that the seeming experiences of "accepting" and "rejecting" manifest in themselves some specific "act" or some specific "activity" or some specific "self-consciousness,"—and that these "acts" and these "activities" or "functions" operate upon a content to accept or to reject it. A hasty perusal or a superficial study of introspections which are in themselves thoroughly descriptive and careful in character might easily lead to just the view that we have mentioned as being founded on unreliable introspective data; and such a cursory study of reliable data might lend itself to the conception also that an observer adopts an "attitude of acceptance" or an "attitude of rejection" to a content recalled in memory, this "attitude" consisting mainly of kinaesthetic, organic, and affective components. Indeed, we were led, in the earlier stages of our investigation, to the latter view, namely, that an observer accepts or rejects a datum or a content of memory by merely adopting an "attitude" to it. But by sympathetically re-experiencing with our observers, living over again with them, their experiences of recall extending over a period of two years, we have been led to other conclusions, the nature of which will become evident as we proceed in our discussion; and a careful and detailed study of the introspective analyses of their memory experiences which has extended over the same period of time has added force to our final conclusions.

Strictly speaking, we cannot say that the observer "accepts" or "rejects" a memorial datum as correct or as incorrect;—to declare that the observer does "accept" or "reject" a content is to speak in general, loose, and every-day language. The content, or the datum, as it is variously called, "accepts" or "rejects" itself. This self-active content may be an image or it may be some form of reflex motor reproduction, such as vocal innervation, manual drawing, or some other form of kinaesthesia. The important point of the "acceptance" or of the "rejection" is the fact that there is manifested no observable "activity," no discov-

erable "function," no manifest "act," which is outside of the content, which is either over, above or against a content. Exterior to the content itself, there are none of the Stumpfian "*Funktionen*" (176) which serve to accept or to reject a content as correct or as incorrect. The content, that is, the image or the reflex reproduction or the kinaesthesia, is in truth a *process*.³⁹ It comes and it goes; it remains stable or it fluctuates; it becomes clearer or it dims; it is attended by many processes or it is unattended; it fuses with other contents or it inhibits other contents; its duration is long or short; it is intense or it is weak; it is durable or it is fleeting; it appears rapidly or it makes its advent gradually; and it recurs, over and over again, or it never reappears. It is a process—it is continually streaming or flowing by. This process-content may at times be accompanied by a kinaesthetic and affective reaction. It was this accompaniment of a content by a reaction of the kinaesthetic-affective kind that at first induced us to suppose that the content was accepted or rejected by the action of an "attitude" working on it. A closer examination of our introspective data, however, sheds additional light on the phenomenon in question; and the kinaesthetic-affective component of the experience is not to be characterized as an "attitude of acceptance" or "of rejection" unless we exercise extreme caution in our terminology. The differentiating criterion has to do with the employment of the terms *with* and *to*. In other words the complex which is termed a kinaesthetic-affective reaction, or an attitude, appears *with*, that is, accompanies, the content or some aspect of the content; it is not an "attitude *to*" the content or some aspect of the content. All consciousness of "relation" or of "act," or of "reference to an object" is lacking. Expressed more adequately, the *process-aspect* of the content occurs as a part of the entire more general attitude-complex. The observer, in most cases, experienced the two phenomena as simultaneous as far as he was able to judge; but he did not experience the reaction as *two*,—it was, in fact, a whole unitary reaction

³⁹ For a philosophical and logical discussion of the point in question, see MacLennan (103). Cf. also Wundt's description of the process-aspects of "ideas," footnote, p. 52 f., this paper.

for him; and even the content itself was an integral part of the whole reaction. Oftentimes the appearing of a content or a change in the process-aspect of the content was a forerunner of the "attitude," the kinaesthetic-affective reaction which we were once disposed to call "attitude of acceptance" or "attitude of rejection." (In this employment of the word "attitude," the term is used for want of a better characterization and when used with "acceptance" and "rejection" it does not connote any element of willing, or choosing, or selecting, or acting on the observer's part; the observer was not aware of functions of selecting or acting or choosing in the experience). Sometimes kinaesthesia of strains and tensions of a general bodily kind preceded the advent of a content or a change in the process-aspects of that content. This kinaesthetic reaction of strains and tensions hardly fits the phenomenon that we are discussing and we have already accorded it a place under the "recall attitude" (p. 84 f.) where it properly belongs. The kinaesthetic-affective complex, or reaction, or attitude, never functioned as an antecedent process; and the content with its changing aspects was, according to the observer's description, an integral part of the complex, very often it was the most focal part; and very often the kinaesthetic (and organic) and affective components were lacking from the complex altogether and the contents were the only components left.

It is well at this point to mention the kinds of component processes which constitute this reaction-complex. Many of the introspections which have already been quoted are illustrative of the points under discussion. Clear, durable, definite, and spontaneous images of recall were accompanied by a relaxed and comfortable attitude of the observer and sometimes he experienced pleasantness; the observer's attention was not long fixed at any one stage of the process but the holding of his attention there was appreciable though not excessive. Attention, or the attentive process here under discussion, means clearness and shifts of clearness and under the latter aspect, of a shifting clearness, are included the coming in and the going out of whole processes. The observer tended to complete his recall at once in one or another manner, or his attention (here employed almost synony-

mously with the stream of conscious processes) forthwith occupied itself with other matters. On the other hand, unclear, indefinite, vacillating images or fluctuations of whole constellations of imagery were accompanied by kinaesthesia of strains and tensions, and often unpleasantness; attention held here for a very long time. This functioning of attention, although a very characteristic one, was not the only phenomenon to fit the conditions; attention frequently shifted in short order and without much ado to other pursuits; or attention, after holding for a short time, turned to other matters, as if reluctant to shift; and in this case attention might shift back as the recurrence of the process which had just disappeared. These are extreme types of attitudes differing from each other by wide margins. There were transitional complexes ranging in between these two, but these two are illustrative types which are closely resembled on one side or the other by the transitional forms of attitudes.

The foregoing description will serve to show that attention, in its functional aspects, was one of the very first factors in memory to show the effects of forgetting, and it will also serve to show that attention was a constant exhibitor of the effects of forgetting. Many points of the introspections which have already been quoted bear evidence of these two facts. It is also a fact that, after forgetting had made a great inroad into the contents of memory and little residua of impression remained, attention still manifested, in its functional manner, certain characteristic phenomena due to forgetting. In this light, then, attention included more than clearness; it included shifts in clearness; and it also included the coming and the disappearing of whole processes of consciousness. By attention are meant practically all of the phenomena characterized as *process-aspects* of mental contents. Notwithstanding the fact that attention played such an effective and large rôle in the experience of acceptance and rejection, there were other factors at work. Among these other factors were such factors as variations in the intensive and in the durative attributes of mental contents; in their functioning, forgetting was manifested in certain characteristic fashions. Stumpf might

contend (176) that the factor of attention was in fact essentially that "self-activity," that peculiar "function"; and that it was "working *on*" the contents. In answer to such an assertion, we might state that attention did not manifest itself outside of the "contents" which have sometimes been supposed (5, 31, and 176) to be affected by the "acts" and by "awarenesses." In the second place, the observer was not aware of accepting or of rejecting a given datum of memory,—the datum in question persisted or disappeared, or what not, and its ultimate fate seemed apparently to be beyond the control of the observer. In the third place, the processes included in our use of the term "attention," since they always occurred as inherent aspects of a content, not outside, over, above, or beyond the content, were determined or influenced or affected by the degree of forgetting. In the fourth place, the intensive and the durative aspects of the contents, with their multitudinous variations, were as significant in determining acceptance or rejection, and in exemplifying the stages of the process of forgetting, as was attention. Finally, the kinaesthetic, organic, and affective components of what we have characterized as an attitude occurred just as frequently with other factors as with that of clearness; indeed, they occurred more frequently with durative and the *process* factors,—for instance, with such factors as spontaneity, suddenness, persistence, stability, and their opposites. If clearness (or Stumpf's "*awareness*") is acceptance or rejection, it would appear that a focally clear datum of memory would be reproduced by the observer and would be designated by him as a genuine recall of the originally learned datum. Very frequently the observer did not reproduce nor did he designate as genuine the clear datum that appeared to consciousness; this fact we have noted on pages 63, 69, 72, and 106 of this paper. It would be equally obvious, were Stumpf's hypothesis correct, that if the datum of memory were unclear or were only marginally clear, this relative lack of clearness⁴⁰ would

⁴⁰ Finzi (56) is said by Meumann (115, p. 100) to have advanced a hypothesis similar to that of Stumpf, namely that the distinctness of the image plays a leading rôle in giving rise to the feeling of certainty or to the acceptance of a datum as correct.

constitute a rejection,—that is, either a failure to include the datum in question or a positive act of excluding it from among those contents which are reported to the experimenter as a genuine recall of the original material. Most frequently this was not the case. The mere fact that a datum made its appearance at a certain point in a certain situation,—no matter how definite or indefinite the datum might be, no matter how great a wealth or poverty of details it might display,—proved to be a potent factor in determining that it be accepted as constituting a part of the content of the recall; and the fact that it disappeared at another point or in a certain situation,—no matter how focal or how lacking in clearness the detail might be,—was also a factor of great import in the rejection of the datum as not genuine and as not belonging to the recall in question.

Attention we have mainly characterized as the functional aspects of mental contents; and we have asserted that the data of memory, besides showing in themselves the effects of forgetting, also exhibit marks of obliviscent damage in the manner in which attention operates in the *process-aspects* of the memory contents. We have found evidence for assuming the existence of four typical functionings of attention, with special regard to acceptance and rejection, and also to subjective assurance and lack of assurance (in a later division of this paper we take up the two latter topics where we shall cite from the introspections data amply covering acceptance and rejection and relating to subjective assurance and lack of assurance). These four types of functioning are roughly indicated in the description of the attitude-complexes (p. 86; 93 ff.). The two which occurred in acceptance, or oftentimes in a consciousness of certainty (subjective assurance), are: I. a slight continuance, or duration, or persistence, or stability, of a given degree of clearness. This was not an impeded flow of consciousness; it was rather a regarding, a noting, a recognizing experience. It manifested itself not only in the fact that a higher degree of clearness was present, but also in the fact that it bore certain contextual process relations with the processes which had preceded it and with processes which

followed it; for example, when this functioning of attention was present, the observer was usually passive, or was comfortable, or experienced pleasantness; he was not concentrating his efforts in an attempt to decipher just what the detail of the memory material might or might not have been; and his consciousness readily turned to other matters. 2. The second type of the functioning of attention was much the same as the first; here perhaps the duration of the functioning was shorter than in the first type. The process was much more rapid in its course and was less intense; the observer barely experienced a certain process, and even this process was present in only moderate degrees of clearness and with slight focality. The observer's stream of processes was occupied elsewhere in short order. The contextual phenomena, such as we described for the first type of functioning of attention, were more conspicuous in the second type. The other two types of the functioning of attention were characteristic of rejection and more particularly of subjective lack of assurance, that is, uncertainty. 3. The third type offered a striking contrast to the first type in that the third type was essentially an impeded consciousness; this impededness manifested itself in continual shifts, vacillations, or oscillations of clearness relations; no one degree of clearness continued for any appreciable length of time—persistency of a certain degree of clearness was not the rule in this functioning. But there was a persistency of this vacillating state and it was characteristic of the experience in question. Here the antecedent and subsequent contextual aspects of the process showed on the one hand, shifts and fluctuations of whole processes, and on the other hand, kinaesthesia of strains and tensions and frequently unpleasantness. It rarely happened here that the observer concentrated upon a detail of the recalled material or that he assumed the "recall attitude" to which we have referred in various places (p. 84 f.). 4. The fourth type was very similar to the third, except that the process of this type had a much shorter duration; its progress was more rapid; it manifested a lower degree of focality; and it usually exhibited no shifts of focal relations. And, too, the context processes were not very prominent here. The observer

was rather skipping, or slurring over, or avoiding the recall of a particular detail; he exhibited a very low degree of concentration and very little effort to obtain the detail or to determine its genuineness. In so far as the interrelationships of these four types were concerned, we may characterize the first type as a richer and more complex variant of the second type; and the fourth type may be described as a mechanized form of the third type. That is, in the period which immediately followed the learning, the second type predominated, and later, in the course of forgetting, this gave way to the first type; soon after learning, when forgetting was still in its incipient stage, the third type was manifested; but, when much forgetting had taken place, the third type gave way to the fourth.

It would be of interest and value to discover what leads the observer to discriminate and select among the mental contents which come to consciousness during his act of recalling, and to decide that certain contents belong to the original material and are genuine recollections while others are intruders which do not belong there. This problem is the problem of acceptance and rejection, which has already been discussed (p. 113 ff.); and all that has been pointed out in regard to acceptance and rejection applies here. But it is to be noted, in addition, that certain factors stamped an image as an extraneous association, and infrequently there were certain factors which stamped another image as one of recall. It often happened that the extraneously associated datum or event was so localized as to give evidence of its extraneous character; it was not localized at the place where the material had been originally presented nor at the point to which the observer's fixation or bodily adjustment was directed. The image frequently bore a vague, far-off character; and sometimes the intervening objects between the observer and the point of localization of the extraneous datum appeared in the margin of focality while the extraneous datum itself was at the focal point. The former phenomenon, the far-off, vague character of the image served to stamp that image as not belonging to the recall being made; and the latter phenomenon, that of distance

and the intervention of objects expressed by the focal relations of the image, served also to characterize certain images as extraneous. It must be said, however, that not every vague and far-off image was labelled or treated as being extraneous; nor was the representation of distance and of intervening objects, by the mechanism of focal relations (see figure of cone, p. 44 f.), always a sure index of extraneousness. This latter phenomenon was well illustrated by an experience of Observer O. who visualized (Series CI 4) the Harvard stadium focally, while glimpses of the landscape between Worcester and Cambridge were marginally present in the visual image; this difference in focal relations, with the intervening landscape, served to stamp the Harvard stadium as being far removed from the observer and from the material being recalled at that moment by him. Frequently just the mere difference in content between that material under recall and the extraneously associated material, without the observer being aware of this difference, was sufficient to initiate a reflex reproduction of the material under recall and the exclusion of the extraneous datum from this reproduction. But here it must not be forgotten that the observer was working under an *Aufgabe* to recall and under an *Aufgabe* to recall a certain material, and since his recall was under way with partial success, we must conclude that certain reproductive tendencies had been set into operation and that these were fulfilling the function of excluding the extraneous contents and the function also of continuing the reproduction of the material which was in line with that called for by the *Aufgabe*. In this manner certain recall materials were controlled, or their recall was directed, by recall-attitudes and attitudes which had been germane to the learning experience (see p. 84 f.; 92). In some fashion the observer imaged, or fixated, or adjusted to, the place of the original presentation; or he imaged the material there. If he were unsuccessful in that procedure, a correct recall was less likely to take place, although he might in desperation adopt a recall attitude with its various strains, tensions, *Aufgaben*, trial recalls, etc. And, as in the case of a difference in content, which served to initiate the disappearance of an extraneous datum, so did a dif-

ference of size often function in a like manner to exclude a non-genuine datum, the observer being unaware of the difference in size. Failure of the extraneously associated datum to fuse with other data, namely those of the original material; its sudden and spontaneous manner of appearing and disappearing, without heralding its advent and without saying farewell; and its failure at other times to reappear at all, were perhaps the most significant aspects characterizing the datum as belonging to the group of extraneous associations. But, as forgetting became progressively greater and greater, the extraneously associated datum tended more and more to acquire for itself a place in the data of the recall materials. The following introspections will illustrate the points under discussion:

Obs. B. Series III 3. Delayed Recall, after 98 days. March 8, 1916. The observer had been recalling the comic picture showing "Pa Van Loon" seated at a table cheerily fingering poker chips; the picture was exposed through a round opening in a black cardboard, and above the opening there was mounted a white card bearing the caption "Poker Shark" supplemented by drawings of a heart, a diamond, a club, and a spade. In the course of time the observer had forgotten the caption card above the picture; it was white, and this fact may have led to the extraneous association which crept into this particular recall. "The visual image of the man, 'Pa Van Loon,' was localized at the shutter; and then on the black background above and to my left there came a visual image of the top of the table and a woman standing behind it facing me; she was larger than the man, who was still in the circle in my visual image; she wore a white apron, a dark waist, her sleeves were rolled up, and a rolling pin was in her hand; at one point she took it up in her right hand as if it were a club. In the first part of this recall, this picture did not appear in the visual image; when it came, it appeared in a detached form somewhat similar to that used by artists to represent a dream; it was not on the black background and was above and to the left of the circle; there was no fusion of any kind between the two visual images; it had come in quickly and spontaneously in the form in which it persisted throughout its entire course; attention was slightly held on it, not in a concentrated fashion but in a relatively passive fashion.⁴¹ The visual image of this woman disappeared from consciousness, and I reproduced the material."

Obs. B. Series II 1. Delayed Recall, after 33 days. January 19, 1916. "In trying to recall the first square of the nine squares, I experienced two or three times the vocal-motor-auditory images 'z—q—figures?—figures?—must have been—'; a visual image of '1522'; then when I was perceptually

⁴¹ See p. 119 f. in regard to this functioning of attention.

fixating the whole square comprising the nine smaller squares, such questioning processes as I have just described kept coming in; there was a visual image, located on the shutter, of a white card at the top of which was a triangle containing a circle; the circle fluctuated in color from a vivid blue, a yellow, to a red; the circle flashed into view and persisted until it became focal; attention remained there a moment, and then kinaesthesia of shaking my head in negation with vocal-motor-auditory 'No, you do not belong to this material; you belong to the color circle'; but it persisted just as vividly. Then came a visual image of the color circle (II 3) with its colored sectors and segments; my visual image of the triangle still persisted, but did not blend with the colored circle material; they were not in the same plane and did not fuse; then the visual image of the colored circle (II 3) dropped out of consciousness; there appeared black lines making a square around my triangle; decided pleasantness and a sitting up straight, making up a sort of 'there you are!' consciousness."

Obs. B. Series II 1. Immediate Recall. December 17, 1915. "There flashed in quickly, clearly and spontaneously a visual image of nine squares on the white paper before me, the paper on which I was to draw; a green triangle with a red ball in it came in square two and I drew it there. In my visual perception, visual perception for I was still looking on the paper on which I was drawing, there was a shift of attention to square one; its whiteness stood out very prominently and continued to stand out; this phenomenon of attention remaining on square one, together with the absence of other processes except strains in my eyes and in my head, made up for me a sort of confused consciousness, a sort of mental blank, meaning that square one must have been occupied by some detail. Finally, after some considerable length of time, there was a release of strains and a vocal-motor-auditory 'Well—go on to something else.'"

Obs. Fg. Series I 1. Immediate Recall. November 23, 1915. "In recalling the smaller football player, I had no visual image of him; I knew he was there, that is, I had a kinaesthetic set, oculo-motor and general bodily kinaesthesia as though I were leaning forward, to see something off in the distance behind the larger player, together with a vocal-motor 'where is that other player?' I could not visualize him, but I was visualizing the larger player."

Obs. Fg. Series I 1. First Delayed Recall, after 21 days. December 14, 1915. "I visualized the larger player in a definite manner; the smaller player developed vaguely in the visual image after eye kinaesthesia of straining and peering into the distance. The whole visual image of the smaller player came in rapidly, but its details developed very slowly; this visual image passed out of consciousness more slowly than it came in."

Obs. Fg. Series I 1. Second Delayed Recall, after 49 days. January 11, 1916. "My visual image of the smaller player was very indistinct; it was separate from the visual image of the larger player except for that part of the visual image corresponding to the larger player's kicking leg."

Obs. Fg. Series I 1. Third Delayed Recall, after 70 days. February 1, 1916. "After considerable roving of attention over my visual image of the figure of the larger football player, there came in quickly a visual image of the smaller player behind the larger player's left knee. What I saw of the smaller player was clear, definite and persistent."

Obs. Fg. Series I 1. Fourth delayed Recall, after 77 days. February 8, 1916. "Eye kinaesthesia of following up the outline of the kicker's body, which developed clearly in the visual image,—and then I had a visual image of the smaller player behind the larger one; immediately I had the vocal-motor *Aufgabe* 'down,' meaning that there was the smaller player and I could proceed with the recall of other details; and my attention left the smaller player."

Obs. Fg. Series I 1. Fifth Delayed Recall, after 100 days. March 2, 1916. "After a visual image of the larger player had developed somewhat, I had the vocal-motor *Aufgabe* 'go ahead—clear enough,—get small player,' and without waiting for my visual image of the smaller player to develop I began to vocalize my recall to the experimenter."

Obs. T. Series II 3. Delayed Recall, after 189 days. December 9, 1915. "I had drawn the circle mechanically after the instructions were given, and had divided it into quadrants; I recalled details in two of the quadrants (we omit here the description of that recall). Then I had a consciousness that the other two quadrants contained some data; this consciousness was an attitude that the quadrants were really filled; it consisted of the standing out of these quadrants in visual perception, for I was actually looking at the paper in front of me on which I was to reproduce the material and on which I had already drawn the circle and marked off the quadrants; a manual kinaesthetic tendency to make small marks in these quadrants, and my attention was impeded in this procedure; I did not leave these quadrants for a long period of time."

Obs. T. Series III 1. Immediate Recall. April 17, 1915. "After visualizing the pictures of the 'Bringing-Up Father' characters in detail, I experienced continued eye-movements up and down over the whole material as though I should be able to recall more details."

d. Certainty and Uncertainty. Meumann (115, p. 100) points out the fact that, heretofore, we have known very little of how the feeling of certainty originates in our remembrances. It is hoped that this section of this paper will throw some light on the solution of the problem.

Our introspections contained numerous references to the presence of explicit conscious experiences which the observer characterized as certainty, or subjective assurance,—and uncertainty, or lack of subjective assurance. In its more explicit and rich

form, certainty was a complex which centered around a peculiar functioning of attention: a characteristic state of a spontaneous, sudden, stable degree of clearness. The complex here was not very unified in regard to its constituent elements,—they could appear in even discursive fashion; and the various components of the complex were not well mechanized into a well-working group of processes. In its richer form a consciousness of certainty may be thus described: the recalled contents made their entrance into consciousness very rapidly, even abruptly but with no need of assistance or effort, that is, in a spontaneous manner; they were clear, definite, intense, and definitely localized; the contents were stable and non-fluctuating, and when the observer reported his recall to the experimenter he described the contents forcefully, positively, emphatically, and more or less reflexly; these contents presented no characteristics of an impeded consciousness; the contents did not fluctuate and disappear only to reappear or recur again; and during the presence of these contents, in the manner in which they were present, and making a part of the entire attitude-complex, pleasantness, and a relaxed, composed bodily adjustment, were experienced by the observer—he experienced a relative lack of strains and tensions, and he was at his ease, so to speak.

The following introspections are illustrative:

Subjective Assurance or Certainty

Obs. B. Series II 1. Immediate Recall. December 17, 1915. "I was absolutely certain as to the content of the second square of the group (the content was a green triangular area upon whose centre was pasted a red disc) and as to the content of the fifth square (the content was a green leaf); and so far as I can tell this certainty consisted of the quickness and the spontaneity with which the images came, their intensiveness, their clearness, and their stability; there was pleasantness, but at other places, on other details, in the recall there were other degrees of certainty, and these degrees of certainty seemed to arrange themselves according to the degrees of quickness, spontaneity, clearness, and stability of images."

Obs. F. Series I 1. Delayed Recall, after 21 days. December 8, 1914. "The rest of the recall proceeded in vocal-motor-auditory imagery of my own voice, followed in many cases by motor imagery of assuming the posture recalled through verbal imagery, such as 'right arm raised,' 'right toe well

pointed,' and the like; all this was called out to the experimenter with a high degree of subjective assurance, consisting in the positive, forceful, reflex manner of my vocalization, pleasantness, and a sort of composure-attitude or a relative lack of strains, and then a flop of attention."

Obs. Fg. Series III 1. Immediate Recall. October 19, 1915. "My experience of certainty consisted of the clearness of my visual imagery, its durability for it did not fluctuate, and the fact that each image disappeared readily; there was no trace of an impeded consciousness."

Obs. Fs. Series II 1. Delayed Recall, after 4 days. May 5, 1915. "When I reached for the paper on which I was to draw the material, the visual image of the squares came back again; there was a rapid shift beginning with the first square, then to the second square, to square four, across squares five and six not stopping on them, and down to square nine; a sweep back to square seven, and this sweep was very rapid; the contents of the squares seemed to become more definite changing to their proper forms instantaneously. All the foregoing experience was a consciousness of certainty that I could recall the material."

Obs. O. Series II 1. Delayed Recall, after 49 days. April 16, 1915. "I was absolutely certain that the content of the fifth square was a leaf; this certainty consisted of the spontaneous entrance of the image into consciousness, its clearness, its persistence, and the fact that attention turned from it readily for other matters."

Obs. R. Series IV 1. Delayed Recall, after 25 days. April 12, 1915. "When the experimenter gave the instructions for me to recall 'Transmigration,' there was a visual image of a library card bearing the caption 'Transmigration' in red ink at the top and underlined in red, and about six lines of words in black ink; they were very vague and were localized in front of me. I turned in my chair and faced the table where the original presentation had been made; I settled back and regarded the visual image which was still localized in front of me. While I was turning there came a feeling of certainty, and this in so far as I can describe was composed of a general bodily relaxation, pleasantness which was not very dominant, the clearness of the visual image, its persistence, its spontaneity in persisting without effort on my part as if it had been there all the time and I had until now failed to give it much attention, and that in turning in my chair and settling back in ease I had removed the barrier and the visual image was right there ready."

Obs. S. Series II 3. Delayed Recall, after 14 days. March 18, 1915. "After my visual image of the fourth quadrant had fluctuated a great many times, there finally came a visual image of one segment in a bright green color of excessive brightness. This visual image of the green segment led to the experience of certainty of this datum of memory, consisting for the most part in the clearness of the image, relaxation of my bodily strains after the images appeared, a general bodily feeling of ease, and the long continuance of the image—it did not flit in and out of consciousness—and my conscious processes turned without much ado to other matters."

Obs. T. Series IV 2. Immediate Recall. November 15, 1915. "The minor details of the material (the material consisted of typewritten philosophical prose having insertions of colors, capital letters, hyphens, underlinings, etc.) came in visual imagery which was accompanied by vocal-motor imagery. Some of these contents disappeared suddenly; the details of which I was most certain were the ones to disappear suddenly; they were focal, definite, and definitely localized. There was a visual image of the word 'US,' which was followed by a visual image of the word 'WE'; but the certainty which attached to 'US,' consisted in its being more definite and in the fact that it was the last process to appear, that is, the visual image of 'US' reappeared but the visual image of the 'WE' did not reappear. Immediately I reacted with 'US' to the experimenter; and there was no tendency for the process to recur or for me to go back to it; and throughout I was comfortable."

Obs. W. Series I 1. Delayed Recall, after 7 days. November 21, 1914. "The clear visual images had attached with them a more active state; this more active state consisted of a slight increase of bodily tension diffused so much that I can hardly localize it, similar to kinaesthetic attention involving the muscles of my face and throat; a sudden developing clearness in the visual image; for the clearest features of the visual image there were very rapid shifts to near features, these shifts entailing no kinaesthesia of eye-movement but being successive in character. Very often the visual imagery had a setting in other visual imagery of previous experimental situations which when occurring are very marginal and which are very rapid and fleeting. With clear visual imagery there was subjective certainty which manifested itself merely as a persistence of a given degree of clearness during the shifts of my attention to different features of the material present in the one visual image."

In its more mechanized form the consciousness of certainty was essentially a peculiar functioning of attention; this peculiar functioning manifested itself primarily as a turn of the processes of consciousness to other matters or to other pursuits, but this shift did not take place until there had been a relatively long persistence of clearness; absolutely, this persistence could be very slight in duration, and it was necessary that the persistence be not too excessive and that it be of a constant and durable kind unattended by shifts or even the slightest vacillation. Included under the factors of a persistent clearness and a shift to other matters were the factors of spontaneity and suddenness characterizing the advent of contents into consciousness. It little mattered what the particular content was or what the datum of the recalled material may have been; if it came to be, or if it functioned, in the manner that we have described, it was

invariably attended with subjective assurance. In making this statement we do not contend that the occurrence of certainty was an easy matter. It was an extremely difficult and infrequent happening for a process of consciousness to fulfill the requirements necessary for giving it assurance; on the other hand, a process of consciousness too often failed to meet the conditions which would have prevented the insertion of incorrect data into the recalled material and which would ordinarily have brought certainty of the contents presented in recall. Besides the type of certainty⁴² here described there were, of course, more rich and more complex experiences of subjective assurance; this richer consciousness of assurance characterized the later recalls,⁴³ while the more mechanized experience of certainty appeared in the earlier recalls. The relative frequency of the occurrence of certainty increased toward the later recalls. This naturally raises the question: when does an experience of certainty or uncertainty arise? Neither of these two experiences ever occurred, save in rare instances, unless some variation in the flow of consciousness had preceded their rise. If the contents of the recall consciousness were at the outset, slow, halting, and hesitant, and if an easier and smoother flow then ensued, certainty was likely to be experienced by the observer.⁴⁴ On the other hand, the observer was likely to experience uncertainty, if an easy flow of consciousness were followed by a halting, or a cessation, of the stream. It is obvious from the facts just stated that both certainty and uncertainty increased in frequency as forgetting progressed and as time elapsed, for the flow of consciousness was slowly becoming more variable in the smoothness of its course and more halting in character. It must be mentioned, however, that the observer's recall might have proceeded in the smoothest flow of consciousness possible and still the observer might not

⁴² These types of the functioning of attention are treated in detail on p. 119 ff.

⁴³ Meumann refers (115, p. 99 f.) to Finzi's (56) results relative to the great increase of certainty with long lapses of time after learning when the objective correctness of memory is greatly decreased. Our results substantiate those of Finzi.

⁴⁴ See Meumann's brief discussion of certainty (115, p. 100).

have experienced a consciousness of assurance; and on the other hand, the observer might have reproduced the material in the most hesitant, slow, broken, and halting fashion, and still he might not have experienced a consciousness of uncertainty. Neither the one nor the other consciousness occurred except after a variation in the flow of processes. The experiences of uncertainty were much more frequent than those of certainty.

Uncertainty, as a conscious experience, manifested, in its richer and less mechanized form, a complex of components clustered around a specific functioning of attention as a core. The components which comprised this experience were practically the obverse of those which characterized the experience of certainty. The type of attention which served as a core to the experience of uncertainty was a slow, hesitant, vacillating, shifting, instable sort of clearness. The processes of recall entered slowly, haltingly, or if they occurred rapidly, just as rapidly did they oscillate and fluctuate, or, again, perhaps the observer strained or resorted to the use of various *Aufgaben* in an effort to initiate certain processes which failed to occur; frequently, the contents of recall were extremely vague. The recall contents appearing did not blend or fuse. Throughout the more complex experience of uncertainty, the observer's attention, or the stream of his conscious processes, was impeded. He did not readily turn to other matters; and, if he did, the former processes, those from which he had turned, were likely to recur and to alternate again. The experience of uncertainty was replete with pauses and mental "blanks." The concomitant processes lacked emphasis; they were characterized by a hesitancy, a lack of force or positiveness; they were characterized by a questioning, a doubtful sort of inflection, etc. The recalled contents were not spontaneous in their appearing. Throughout the more complex form of uncertainty, the observer experienced unpleasantness, and strains and tensions; he was not at his ease,—he was not composed.

The experience of uncertainty, unlike that of certainty, manifested three stages of functioning in the recalls after long intervals of delay. The first stage possessed no great number of the

various factors which have been designated as belonging to the experience of uncertainty; but the factors of vacillation, alternation, and an obstructed consciousness were not mechanized nor were they very rapid in temporal course; for instance, the first content to occur after fluctuation, may have been the last process to occur, thus terminating the experience, while attention turned to other matters. The second stage of the functioning of uncertainty made its advent when the amount of forgetting had increased. This stage manifested all varieties and the greatest profusion of processes constituting subjective lack of assurance. It was the more complex and the richer form of the experience. But, a little later in the course of forgetting, when fewer details were recalled, and when many of the uncertain details had vanished or had almost vanished through failure to recall them, we found quite a mechanized experience of uncertainty; this was the third stage. It consisted mainly in the slow appearance of a content, then a slight persistence or slight shift of its clearness, and then the content disappeared. This third stage of uncertainty was similar to the fourth type of the functioning of attention described on p. 120 f. It was a sort of skipping, or omitting, or a passing of consciousness over, a content of recall. The impeded consciousness, which, we have seen, was so characteristic of uncertainty in general, was in this stage of functioning very slight, hardly noticeable.

The following introspections are illustrative:

Subjective Lack of Assurance or Uncertainty

Obs. B. Series II 3. Delayed Recall, after 7 days. November 24, 1915. "I fixated the third quadrant, that is I visually perceived the drawing which I had already begun; vocal-motor-auditory 'yellowish-red,' and then a visual image came of this color projected into this third quadrant; then vocal-motor-auditory 'blue.' Then came an experience of uncertainty: eye kinaesthesia toward the lower part of the circumference of the circle, and this kinaesthesia then ceased, and there came manual kinaesthesia of reproducing the drawing farther up in the quadrant; there was a repeated alternation of 'square' and 'yellow-red' in vocal-motor-auditory imagery; I experienced strain in my eye-muscles as I fixated the paper on which I was to draw; quickly and very clearly there appeared a visual image of a bright yellow square which immediately dropped out of consciousness; and vocal-motor-

auditory 'NO!' and a kinaesthetic tendency of my eyes to move toward quadrant two, my attention turning to other details."

Obs. F. Series II 2. Delayed recall, after 12 days. November 1, 1915. "Vocal-motor images of the words 'Soldiers' Drill—printed' came in a fairly rapid manner; then there was a slow vocal-motor 'colored?—green?—green?—yes, green—' which was characterized by a low degree of subjective assurance; this low degree of subjective assurance consisted of the slowness of the vocal-motor images, the questioning inflection with which the images appeared, and the frequent pauses in the imagery; my attention was obstructed or impeded."

Obs. Fg. Series V 1. Delayed Recall, after 35 days. January 11, 1916. "My uncertainty of the spot under the mannikin's left eye consisted of a visual image of it as located there, the disappearance of this visual image, then vocal-motor imagery of 'two spots,' but no visual image came to localize the two spots; attention held on the mannikin's eye for a short while and my attention slowly left it for other details."

Obs. Fs. Series V 2. Delayed Recall, after 73 days. March 30, 1915. "I experienced uncertainty in regard to his hair (the hair supposed to have been possessed by the mannikin) and this uncertainty consisted in the fact that the visual image shifted and persisted, attention being held on it or going to it frequently; there were relatively few strains or tensions; for that moment consciousness was impeded but finally in the course of time shifted to the recalling of other details of the material."

Obs. O. Series CI 5. Delayed Recall, after 21 days. December 15, 1915. "The uncertainty which I experienced here was composed, so far as I can tell, of these factors: the clearing up of my visual image and then its sudden disappearing not even remaining in the margin of consciousness, the lack of cohesion or fusion among the details of the visual image and the isolation of the elements in it, the lack of past associations which would give me aid in deciphering the details of the material; the images that came were not spontaneous and I was experiencing strains in my eyes, forehead, neck, and face, and unpleasantness, in my effort to recall the material."

Obs. R. Series V 1. Immediate Recall. April 29, 1915. "I was uncertain as to whether or not the mannikin's hands were held palms up; this uncertainty was describable in terms of the facts that my visual image was vague as to that detail; attention was occupied a long time in the vocal-motor-auditory description of that detail; a shift from the visual image of the mannikin's hands to an actual visual perception of my own hands; then the mannikin's hands became clear and persisted in clearness in a visual image; then attention busied itself elsewhere."

Obs. S. Series II 3. Immediate Recall. March 4, 1915. "In the lower left-hand section of the third quadrant I had an intense experience of uncertainty or of hesitation; my visual image of the color fluctuated, and I experienced unpleasantness and with unpleasantness strains of frowning and of being ill at ease; my conscious flow was impeded but I staid with the

task of recalling and my attention did not turn to other matters at this moment."

Obs. T. Series IV 2. Delayed Recall, after 3 days. November 18, 1915. "The word 'US' stood out in visual imagery but alternated from being just a red space to being two black capitals; the image of the black capitals was the first process of the fluctuation, that is the first to occur, and it was the process with which the experience terminated, that is, it was the last process; the image of the red space after alternating with the black capitals once did not reappear; there was during this an organic and kinaesthetic set of being in doubt, of wavering in hesitant fashion between two alternatives and of being tensed and quiet."

C. SUMMARY

1. An observer undertakes to recall learned and retained materials in a manner which is strikingly similar to the procedure he employs in learning the material; this similarity manifests itself in imaginal type, in the use of both pertinent and extraneous associations, in the manner in which clearness relations behave in the contents, in the rate and the direction of the coursing of contents through consciousness, in the unity and the discreteness of a mass of contents, and in the adoption of learning attitudes.

2. In an observer's learning and remembering, the *process-aspects* of his mental contents are always very important carriers of meaning; these processes or functions of contents are not to be regarded as existing outside of mental contents but as contents themselves in function.

3. In the course of forgetting there come into operation mechanisms belonging peculiarly to the process of forgetting; these mechanisms are a process of *typification* and a process of *analysis*. Besides these mechanisms there are operative the mechanisms of *condensation*, *displacement* or *transposition*, *dramatization*, and *secondary elaboration*. The latter four mechanisms are just as characteristic of forgetting as are the former two, and on their faces they bear no evidence of having resulted from the repression of sexual complexes; they lead one to believe that forgetting itself, appearing in the forms of dissociation and assimilation, is responsible for both the character of dream images and the character of memory images and images of imagination.

4. Typification is a process very similar to a process of generalization; instead of being a re-organization of details, some of which have been lost, as in a generalized content, it is a progressive functioning of a developing sort of clearness, and this development occurs from recall to recall, so that finally, in the later recalls, the clearness relations are represented in the form of a cone: the apex of the cone, near and pointing toward the observer, would represent the clearest detail, the detail which typifies or represents similar details or details which had been twins or triplets in a material, and the surface of the cone extending toward its base away from the observer would represent the less and less clear details; the base would represent the most obscure details. It is significant of this process of typifying that the details which grow to the maximum degree of clearness are details which are most essential to the integrity of the dominant meaning represented by the learning material. The most important fact concerning this mechanism, so far as the process of forgetting is concerned, is that it is a source from which images will lose details and will in the course of time become more and more schematic and syncopated and ephemeral.

5. The mechanism of analysis has its beginning in the shifting of clearness from detail to detail in one image, the more striking and the more important details standing out very clearly, and the outlines of the material being followed out until dominant *foci* of clearness are reached. This mechanism is a potent source from which there issue, in the course of forgetting, disintegrated and discrete images; and these images will more and more, in the course of time, tend to come to consciousness in a successive, discursive fashion, each being a new entity in itself.

6. Typification and analysis are kin, for in the course of time when forgetting has made much headway, they are responsible for a great many subjective interpolations and are open roads for much subjective alteration in and addition to the original contents.

7. The phenomena of forgetting result from the operation of at least two somewhat reciprocal processes, namely: a process

of disintegrating and losing of details with a characteristic typifying of contents,—this process we call dissociation (which we have mentioned in conclusion number 3); and a process of subjective selecting, interpolating, and clarifying with its characteristic mechanisms of condensation, transposition, and elaboration,—this process we call assimilation (which we have mentioned in conclusion number 3).

8. The interpolative, constructive or additive process progresses much more slowly than the destructive or subtractive process, and is very largely dependent on it for existence. However, as the time elapsing since learning increases, and the effects of forgetting grow larger and more striking, the assimilative process moves with greater acceleration and with greater momentum.

9. The additive and alterative process is more likely to affect these two sorts of contents: minor details which are similar to details comprising the dominant meaning of a material and which in themselves conduce to this very dominant meaning; and details referred to by the observer in his various remarks during the act of learning and during his acts of recall, those details being perceived with an undue degree of clearness during the original presentation or which were perceived to conform to this or that relation, the relation being the observer's own contribution to the act of perceiving, and various details which called up associated details from other materials and other experiences. In regard to minor details which are conducive to the dominant meaning of a presented material, we may say that their extraneousness is a factor which leads to their independent survival, in discrete images, and that their similarity to essential details is a factor which leads to their being qualitatively altered in the course of time to fit the main context of the dominant meaning. The observer's various remarks, inferences, remote associations, and perceptual contributions, all making fertile soil for the arousal and growth of subjective constructions, alterations, additions, re-combinations, etc., in the course of forgetting, show great strength and come to the fore in great numbers when

there is a great discontinuity of content and when forgetting has weakened and broken associative bonds. Jost's law finds no greater confirmation than these subjective interpolations, many of which had their rise in the act of learning when the observer perceived the material, his associations growing progressively stronger than those artificially presented by the experimenter.

10. In addition to the mechanisms which we have described as being essentially constituent processes of forgetting, namely typification, analysis, condensation, transposition, and elaboration, all included under the processes of dissociation and assimilation, there are at least two mechanisms which indicate the presence of forgetting for reason of the very fact that they resist forgetting and they change forms in the course of time due to the effects of forgetting on them; they are the mechanisms of certainty and uncertainty, and acceptance and rejection. Each of these mechanisms passes through various degrees of mechanization and syncopation, from mechanisms wealthy and large in content to mechanisms exhibiting a poverty of contents and which are extremely schematic and fragmentary.

11. Certainty in its more explicit and rich form is a complex which inheres around a peculiar functioning of attention, this peculiar function of attention being a clearness which rises to its maximal intensity very suddenly and very spontaneously and whose most characteristic feature is stability and constancy, even though this state of clearness be short-lived; it is a peculiar form of stableness and we are inclined to assert that it is the heart and core of the mechanism of certainty, and, notwithstanding the fact that the experience is one manifested in clearness, the clearness itself is in function and is not a static sort of clearness nor is it one which appears outside of some content; in short, certainty is this peculiar, constant, stable, non-fluctuating aspect of clearness, not simply isolated clearness as Stumpf might contend (176). Uncertainty, on the other hand, is a slow, hesitant, vacillating, shifting, instable sort of clearness; or rather it is the inconstant, instable, fluctuating aspect of clearness. These results, as to the very important character of the process-aspects

of clearness in forms of resistance to forgetting and as processes of a logical memory, are new or are relatively so, but one has to look only at the phenomena of perception and the rôle of clearness in perception, particularly at those mechanized forms of clearness manifested in reversible perspective illusions, in abstraction and conception (57), in classifying (58), in recognition (211), and in understanding,—one has to look only here and one will find many phenomena of a striking kinship to those that pertain to experiences of certainty and uncertainty.

12. The mechanism of acceptance, or of rejection, is unlike the mechanism of certainty, or of uncertainty, by virtue of the fact that it most frequently functions as a reflex, automatic act, and has few if any conscious components or characteristics; Ach's *determinierende Tendenz*, meaning the reproductive tendency influenced or determined by the *Aufgabe* to recall a definite material which was once learned, is the best characterization for the mechanism, and this term is found to be a most suitable one for the reason that, as forgetting makes greater and greater inroads into the contents of memory and more and more associative bonds are broken and the contents become more discrete and discontinuous, the *Aufgabe* to recall a definite material becomes less and less effective, and more false and extraneous associations are inserted into the recall contents as genuine reproductions of the original material. Another dissimilarity between the two sorts of mechanisms consists in the fact that, while certainty or uncertainty was manifested in some peculiar constancy or inconstancy or fluctuation of a given degree of clearness, acceptance or rejection has nothing to do with clearness either as a static process or as a moving and fluctuating phenomenon; rather acceptance and rejection is manifested in the entire coursing through consciousness of whole constellations or strains of contents, on one hand, and in the completion or termination of reflex reproductions and the turn of consciousness to other matters, on the other hand. There is no specific conscious experience, or act, of accepting or rejecting a content of recall as genuine or non-genuine. When the mechanism manifests itself in its more

complex and rich form, there are found many conscious concomitants of the experience in the manner of kinaesthesia of strains and relaxations from strains and the occurrence of pleasantness or unpleasantness; but very often these accompaniments are entirely lacking. When they do occur, they frequently accompany the intensive and the durative aspects of the contents as well as the mere occurring to consciousness of certain contents regardless of how great a degree of clearness these contents may possess or how constant or instable the clearness may be. The mere fact that a content of recall made its entrance into consciousness at a certain point in a certain situation,—no matter how definite or indefinite the content might be, no matter how great a wealth or poverty of details it might display; or the mere fact that consciousness turned to other matters in short order or with little ado, proved to be a potent factor in the functioning of the mechanism and may be conceived as an act of acceptance although the observer was in no degree aware of the act or that he was acting. And the fact that the content disappeared at another point in a certain situation,—no matter how focal or how lacking in clearness it might be,—was also a factor in the operation of the mechanism and may be termed a rejection of the content as not genuine, although the observer was not aware of any act or of acting.

13. The more mechanized form of certainty characterized the earlier recalls, the recalls when forgetting had made little progress and had resulted in little damage to the memory contents; the more complex form of certainty characterized the later recalls, the recalls which exhibited the effects of a great degree of forgetting, when the contents were very fragmentary and discrete and when subjective interpolations in great number had been added and when assimilation had effected striking alterations in the contents. These facts would lead one to suspect that certainty is a product of an observer's own organized associations, and that when these are thwarted or their functioning is hindered or impeded, there arises an experience of uncertainty. This conjecture is borne out by the following facts that: if the

contents of the recall consciousness were at the outset slow, halting, and hesitant, and, if an easier and smoother flow then ensued, certainty was experienced by the observer; and, if an easy flow of consciousness were followed by a halting, or a cessation, of the stream, the observer experienced uncertainty. Neither certainty nor uncertainty was exhibited by the observer unless after a variation in the flow of processes, and, therefore, we must conclude that this variation is responsible for the arousal of certainty and uncertainty in recall experiences. This throws further light on the fact that, in the earlier recalls when forgetting was in its incipient stage and the contents were being dissociated and variations were beginning to occur in the flow of processes, uncertainty was experienced more frequently than certainty,—but when assimilation had gained the ascendancy over dissociation, in the later recalls, the relative frequency of certainty increased despite the fact that the objective correctness of the contents was steadily being more and more impaired.

14. Attention, regarded not only as being clearness but also as being the functional aspects, the process-aspects, of mental contents, is one of the very first factors in memory to show the effects of forgetting and it is always a constant exhibitor of the effects of forgetting. Other investigations have discovered and it is generally held that the direction which one's train of associations will take is largely determined by the functioning of attention,—that attention brings to consciousness certain contents of recall and excludes from consciousness other contents in proportion to the "intensity," the "systematic complexity," and the "effective co-operation" of the associations in which attention manifests itself,—that attention mainly determines what shall be the observer's attitude in making his recall,—and that the distribution of attention is responsible in large part for the size of the recall image. This experiment has ascertained, we hope beyond all possibility of doubt, that the functioning of attention,—the "intensity," the "systematic complexity," and the "effective co-operation" of associations,—and the distribution of attention are all affected, if not wholly determined, by the

amount and the character of the forgetting which has taken place before the recall is had. Regarded in the light of these facts, forgetting is not a passive affair but is primarily an active, dynamic function, which operates in a cumulative fashion to produce more forgetting, and once under headway will serve as an agent to break and to obscure other associations and to knit together still other associations and to contribute to the form of all sorts of subjective constructions. As to the purpose, or the teleology, of such a function called forgetting, and as to the source whence it obtains its driving force, this paper is not concerned; we are not disposed to go behind the scenes and behind the facts in an effort to speculate as to the purpose of such a mental function; we are not inclined to say that the individual is thus striving to be the largest, best personality of which he is capable. We are ignorant as to the meaning of it all.

15. There are at least four types of the functioning of attention which manifest themselves in conjunction with the mechanisms of certainty and uncertainty, and acceptance and rejection. These four types are: 1. A clearness which possesses a high degree of focality and which persists in just that state for an appreciable length of time without vacillating or shifting. The consciousness here exhibited is not an impeded one; it is rather a regarding, a noting, a recognizing consciousness. It possesses also a peculiar contextual relationship with the process-contents preceding and following it, such for instance as kinaesthesia of passivity or comfort with a feeling of pleasantness. The consciousness gives place readily and spontaneously to other contents. 2. A clearness less intense than that of type 1, but which possesses a shorter duration and whose course is more rapid; this clearness is just as free from vacillation or instability as is clearness 1. The stream of processes turns more quickly and more spontaneously to other matters than was the case in type 1. Contextual and accompanying phenomena, such as kinaesthetic and affective contents, are more complex and rich and occur in a very conspicuous manner. 3. A clearness which can be described as an impeded and a halting consciousness. There are continual

shifts, vacillations, and oscillations of the clearness relations of contents, no one degree of clearness persisting for any appreciable length of time; but this vacillating state of the clearness relations continues until the observer becomes weary. There occur also shifts and fluctuations of whole trains of contents, and with this unsettled state of affairs there is a conspicuous wealth of kinaesthesia of strains, and feelings of unpleasantness; but, notwithstanding this perplexing functioning of contents, the observer rarely concentrates upon a detail or assumes even a "recall attitude." 4. A type of attention very similar to type 3, but with a lower degree of focality and a course much more rapid; there are few shifts of focal relations although there are a great many fluctuations of whole contents. Contextual phenomena in the form of kinaesthesia and affection are relatively lacking, and closely allied to this is the fact that the observer exerts very little effort to obtain a detail of recall or to determine the genuineness of a detail,—he is rather skipping or avoiding or omitting a particular detail. These four types are interrelated: type 1 is a richer and more complex variant of type 2; and type 4 is a mechanized form of type 3. In the period which immediately followed the learning of the material, type 2 predominated,—and later, when forgetting had progressed further, type 2 gave way to type 1. Soon after learning, when forgetting was in its most incipient stage, type 3 was manifested,—and when much forgetting had taken place, several months after learning, type 3 gave way to type 4.

16. Affection proved to be a disappointing factor in the determining of the accuracy and the fidelity of memory and recall of details of materials employed in this investigation; in fact, there was no discoverable correlation between presence of affection in learning and perceiving, and accuracy and correctness of recalling. Whatever affection attended the presentation of a material for learning tended to disappear at once, and the immediate recalls and recalls after one or two weeks showed no traces of the original presence of affection. Notwithstanding the lack of observable effects, in recalls, of affection germane to the act of

learning, the later recalls, those recalls after forgetting had made extensive ravages on the memory contents and when assimilation had been more and more active in bringing to light the observers' own organization of associations and effecting various subjective constructions and interpolations and alterations, there was a very noticeable increase in the presence of unpleasantness and pleasantness. This state of affairs would lead one to wonder what is the nature of affection? and when does it arise in one's repeated recalls of learned materials? The writer is inclined to the view that pleasantness is a process of the fitting in or the congruity of an association with an observer's organization of associations, and if the fitting in is easy or is facilitated, no resistance being offered by the subjective mass of associations to the incoming member, the observer experiences pleasantness; and that unpleasantness is a process of failing to fit in, or of hindrance or resistance to the entrance of a new association into an observer's organized mass of associations. Confirmatory support is given this hypothesis by the fact that in this investigation, in the delayed recall after learning, affection seemed to occur only at points of success or failure to recall. This fact is understandable in view of another fact, namely the fact that the observer was working under the *Aufgabe* to recall, and we can assume that this *Aufgabe* served to arouse a mass of reproductive tendencies to recall a certain material asked for by the experimenter and which the observer had once learned. The appearing of any datum, whether correct or incorrect, just at the moment when the observer's efforts to recall were most active, contributed to the feeling of pleasantness. The failure of the observer to "get started" upon a recall, or his failure to remember any datum in a recall, usually contributed to the feeling of unpleasantness, this experience of unpleasantness being the more intensive the greater the observer's efforts to make a recall. Moreover, affection played only an accessory or an incidental rôle in the observer's recall; it never preceded the observer's efforts to recall and usually followed after such efforts. In not a single instance in this investigation did affection usher or escort a datum of recall

into consciousness and did affection remain behind, after forgetting, as the only content left by the process of forgetting. In view of these facts, we are inclined to dissent from the views held, on one hand, by Thorndike (181 and 183), Tait (179), Hollingworth (74), Colegrove (42), and Kowalewski (86),—that pleasantness exercises a stamping-in valence and that in consequence of it pleasant experiences are better remembered than unpleasant data of learning,—and, on the other hand, by Abramowski (1, 2, 3, and 4),—that after all other contents of learning have been forgotten, there still remains the feeling-content which actively resist the entrance of false data to supplant the forgotten details.

17. This investigation has yielded no evidence to show that affection is in any fashion related to organic sensations or organic images, or any organic consciousness whatsoever. Moreover, there is no observable relation between the occurrence of affective processes and the occurrence of kinaesthesia in any form whatsoever. Our data bring to light not one specific form of kinaesthesia for pleasantness or for unpleasantness; nor do our data give the slightest hint of any "pattern" or complex of kinaesthetic components which functions as either pleasantness or unpleasantness. Pleasantness was found to be present frequently with no kinaesthetic or organic accompaniment whatsoever; and various forms of kinaesthetic and organic consciousness were present with no pleasantness whatsoever. Moreover, pleasantness was often found as an accompaniment of strains and tensions and of an increase in the intensity of strains and tensions. On the other hand, unpleasantness was frequently manifested without the accompaniment of kinaesthesia or organ-aesthesia, and various forms of kinaesthesia and organic consciousness were in evidence unattended by unpleasantness. And, indeed, unpleasantness frequently attended a decrease of strains and tensions, oftentimes occurring with a total relaxation from strains and tensions.

18. As a determiner of the correctness or incorrectness of a recall, and as regards its rôle in experiences of acceptance and

rejection and certainty and uncertainty, in an observer's logical memory and his resistance to forgetting, affection played no more than an incidental service; in fact, there is no discoverable determining influence that can be ascribed to the affections in recalls after short and long periods of delay after learning in experiments such as were conducted in this investigation. Whatever influence one might ascribe to the affections in these experiments seems somehow to be bound up, on the one hand, with an observer's subjective organization of his own associations, and, on the other hand, with an observer's successful and unsuccessful attempts to subscribe to and to carry out the *Aufgabe* to recall, regardless of the accuracy and the correctness of the recalled data, and regardless of the genuineness or the non-genuineness of the subjectively presented associations.

19. The visual image of the immediate recall is a highly organized mental process; it contains a great number of details and features or elements which are systematically knit together and unified into one single process in such a manner that the several components do not appear in even a composite character,—these several details or components are simultaneously present to consciousness and the more typified the clearness relations of the details the less do they appear to consciousness in discrete or discursive fashion, and the less do shifts of clearness occur within the details in one image. Closely resembling the visual image in its composition of details or features and in its being unified and well-knit, the empathic image is a simultaneous presentation of kinaesthetic features which are not to be called even components, for they are somehow more typified and more ephemeral and more unconstrained than are the features of a visual image. The visual image contains many more features condensed in a much smaller compass than does the empathic image, but the empathic image is of broader compass, often involving the muscles of the entire body in such a manner that the observer cannot definitely locate the various constituent kinaestheses, and possesses a much more perfect unification and typification of clearness relations. Since each image, the visual and the empathic, is

a simultaneous presentation of details or elements all organized into one constellation or into one mass, more or less perfectly unified, each affords suitable conditions and each is the fertile field for disintegration as forgetting progresses; out of each whole image of the immediate recall there will issue separate, discrete images, and these will appear in consciousness in successive fashion or they will offer a premium to fluctuations and vacillations and oscillations of whole, discrete images, in plenty. But, of the two kinds of images, namely visual *versus* empathic, the visual image of the earlier recalls is the most accurate and the most efficient representative of positions, forms, shapes, sizes, directions, and spatial relations; however, in later recalls the empathic image comes into its own and is now more efficient than the visual image for positions, forms, shapes, sizes, directions, and spatial relations. This fact is understandable in the light of the fact that at the outset the empathic image was more highly organized and unified than the visual image and therefore suffered less disintegration; and it is to be explained by another fact, namely that it seems well established by our data that in the course of forgetting visual and other sorts of contents are entirely or almost entirely lost and the kinaesthetic modes of representation then bear the burden of conserving and of recalling the contents and function as vicariates for the missing modalities.

20. The auditory-vocal-motor image is especially characterized by the fact that it is a train of successive details or contents. Its succession of contents affords a very favorable condition for the total loss or exclusion of entire images or entire trains of images. A given auditory-vocal-motor image of the immediate recall suffers very little in itself or within its own contents as forgetting advances; that is, very few qualitative changes or quantitative alterations are effected in it by forgetting; but, of a train or constellation of auditory-vocal-motor images, of the immediate recall, a great number of entire images may have dropped out in the course of forgetting when much time has elapsed since the immediate recall, or the images are juxtaposed and transposed, or they may alternate and fluctuate

in a most confusing manner. A train of auditory-vocal-motor images manifests the effects of forgetting in two forms. On the one hand, the train or flow of images tends to become more rapid and the duration of each content in consciousness tends to become more transient,—this form of mechanization being accompanied by an ever increasing amount of syncopation and schematizing of contents and an increasing degree of looseness and detachedness between contents. On the other hand, the auditory-vocal-motor images take on significant modes of inflection as forgetting becomes more pronounced,—these changes of inflection are essentially characteristic of hesitancy, doubtfulness, slowness, forcefulness, emphasis, etc. The relative number of auditory-vocal-motor images grows larger and larger as forgetting makes greater headway and as time elapses.

21. A kinaesthetic image represents the details of a learning material in only a rough and indicative fashion; fine details of position, form, size, direction, and spatial relations are not present in the image, or if they are present, they are very schematic and hazy. But we find that a given kinaesthetic image suffers least, of all images, from the effects of forgetting; in fact, a given kinaesthetic image shows the effects of forgetting far less than even an empathic image. The nature of the slight effects of forgetting on kinaesthetic images consists, on one hand, in their alternations and fluctuations, their arrangement in erroneous combinations or sequences, and, on the other hand, in their becoming more general and more roughly representative of the material once learned. The relative increase of the number and of the importance of kinaesthetic forms of recall-processes, as forgetting becomes more evident, and the slight effects of forgetting on them, are striking phenomena, and they furnish us little evidence which can be used to explain the causes of such an interesting state of affairs (although Washburn has attempted [195] an explanation and Russell has been [162] no less ingenious in explaining the phenomenon).

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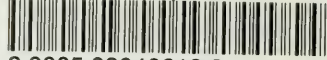
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